"The New York, West Shore, and Buffalo Railway, and the Methods used in its Construction."*

BY PETER CHALMERS COWAN, B. SC., EDINBURGH, STUD. INST. C. E.

This railway is described as a new double-track low-grade direc trunk line between New York City and the "Great Lakes." Its route is from Weehawken, opposite the City of New York, along the west shore of the Hudson River to Albany, through the Mohawk valley to Utica, and thence to Syracuse, Rochester and Buffalo. The main line is 425 miles in length. The terminal depot at Weehawken is to be brought into communication with New York by large and swift ferry boats, and may easily be connected with the tunnel now in process of construction under the Hudson River at New York.

The railway is the first trunk line of similar length which has been built from the outset as a first-class double-track road, and its location, alignment and gradients have been carefully designed for the economical handling of a definite volume and class of traffic. Nearly all the other trunk lines in America were imperfectly located and cheaply constructed at first, and have had to be practically rebuilt. They have also in many cases been formed by the consolidation of small, tortuous roads, built originally for local traffic only. The doubling of a single-track railway is very expensive; for example, although there may not be much masonry to add, a large part of the wing-wall and abutment work has to be torn down and rebuilt, and the additional land needed is difficult to acquire.

The New York, West Shore and Buffalo Railway connects seven of the thirty-two cities in the United States, which have each a population exceeding 50,000.

The four existing trunk lines from the Atlantic seaboard to the West were opened nearly thirty years ago. Since then, the population of the country west of Pittsburgh and Buffalo has increased from less than 6,000,000 to more than 19,000,000 and the railway mileage from 6,000 to 53,000. For nearly its entire length the "West Shore" Railway is in the State of New York, which contains one-tenth of the total population of the United States.

For one-third of its length the railway is level. The "prevailing maximum grade" (Rankine's "ruling gradient") is 20 ft. per mile going east, the direction of the heavier traffic, and 30 ft. per mile going west, and these limits are only very slightly exceeded for short distances. On the New York Central Railroad, gradients of 86 ft. per mile have to be overcome for considerable distances; on the Pennsylvania Railroad of 95 ft. and on the Baltimore and Ohio Railroad of 116 ft. per mile. The importance of these differences may be conceived when it is remembered that,

taking the tractional resistance on a straight level as $\frac{w}{280}$, the resistence on an upward incline of 19 ft. per mile is twice as much.

Four-fifths of the railway is straight. The designed maximum curve was 4° (or one with a radius of 1,432 ft.,) but in the difficult work along the Hudson River this curvature was exceeded in one or two instances. West of Albany there are only two curves sharper than 4°, namely, a 4½° curve in the city of Syracuse, and a 5° curve 900 ft. long. The curves are usually from 1° to 3°. This straight alignment allows greater speed than could otherwise be safely used, and besides saving power and wear and tear, prevents the discomfort experienced by passengers when trains are run at high speed round sharp curves.

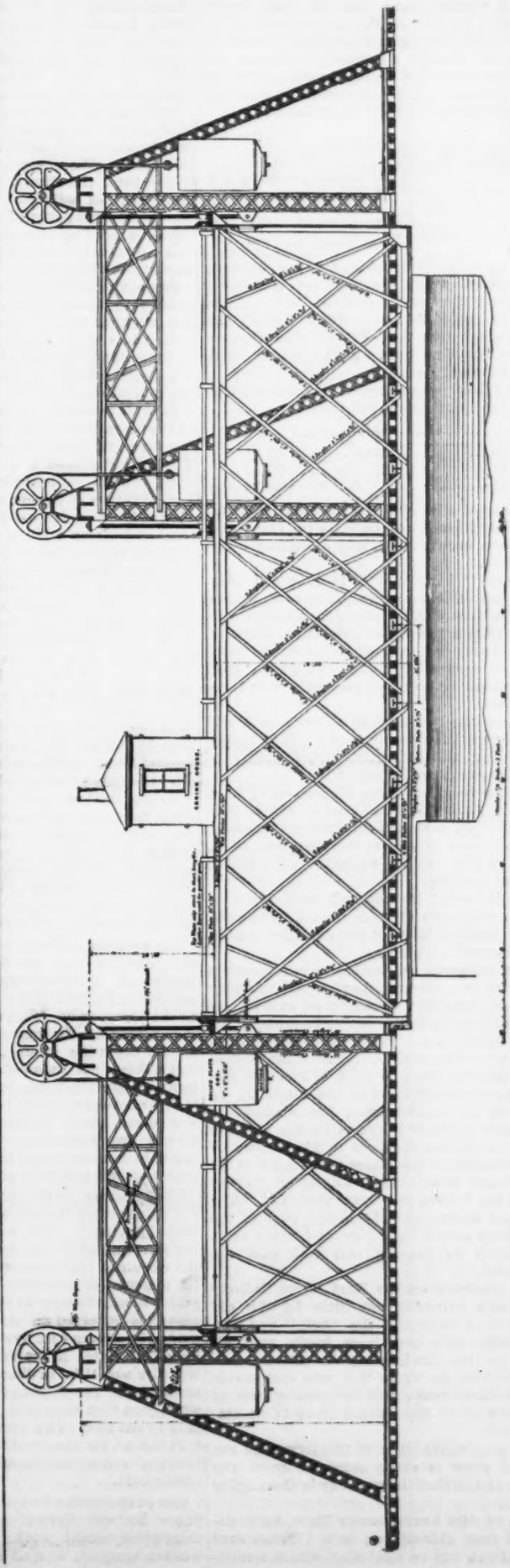
The formation-level on the profiles is 18 in. below the base of rail, and shows the height of the slopes. From the top of the slopes to the center-line the formation rises 6 in. for double-track and 3 in. for single track, to facilitate drainage. The width of formation at sub grade is as follows:—

	Single Track Feet.	Double Track. Feet.
On embankments	15	28
In earth excavation	20	33
In rock "	17	30

Figs. 1 and 2, show how these dimensions are measured. It should be noted that the ditches shown are of minimum size, and that in wet cuts the formation is widened and the ditches are enlarged to suit the special circumstances. The double-track widths detailed above are about 2 ft. greater than the average in New York State, and on the West Shore Railway the "6 ft." way measures 7 ft. 10½ in. The additional clearance is necessitated by the great width of the parlor and sleeping cars used in America. The tracks of some of the important railroads in New York State are too closely spaced. In the summer of 1882, two cars on passing trains on the New York Central Railroad tore the sides out of each other.

To prevent a "rocking grade" at a summit parabolic vertical curves are occasionally employed on the West Shore line. With a view, probably, to economise ballast, a general order was issued that the curve should be formed on the earthwork, but this instruction was not carried out, and the curving was effected in ballasting.

*From Other Selected Papers of the Institution of Civil Engineers.



RAILWAY LIFT BRIDGE—OSWEGO CANAL, SYRACUSE N. Y.

The vertical-curve practice was lightly esteemed by some of the most experienced of the division engineers, who considered a short, level line as good a connection between two opposite gradients as a vertical-curve, and especially so with a low system of gradients such as that of the West Shore Railway.

	Hor. Ver.
Earth, embankments, cuttings and ditches are sloped	1½ : 1
Earth and gravel excavations are sloped from	1 : 1 to 1½ : 1
Loose rock and "Hard Pan" excavations are sloped from	¼ : 1" 1 : 1
Clay and other slipping materials are sloped from	1½ : 1 " 3 : 1
Solid rock excavations are sloped from	¼ : 1 " ¾ : 1

On "grading" the contractors are paid only for excavation, and the prices are understood to cover the entire cost of shifting the material, provided the average "haul" does not exceed 1,000 ft. Beyond this distance "extra haul" is allowed at the rate of ¾ cent. per cubic yard per 100 ft.

The prices per cubic yard for excavation on the West Shore Railway are:—

Earth	24 to 28 cents.	
Hard clay	35 "	
Hard pan	55 to 70 "	
Loose rock	55 " 70 "	
Solid	$1.15 " $1.50 "	
Excavation in water	80 "	plus dry price.

A special allowance of 31 cents per cubic yard (additional) was made for the excavation of frozen earth, which was ordinarily about 3 ft. deep.

"Earth" is defined to include soft clay, sand, gravel, loam, decomposed rock, stones, and boulders of less capacity than 1 cubic foot.

"Hard pan" includes quicksand, tough indurated clay or cemented gravel which needs blasting, cannot be ploughed with fewer than four horses, or required two pickers to three shovellers.

"Hard clay" is material between earth and "hard pan," that requires one picker to two shovellers, and can only with difficulty be ploughed with two horses.

"Loose rock" includes all masses of stone between 1 cubic foot and 1 cubic yard in size; also all slate, shale and soft friable sandstone; also all rock in strata not exceeding 8 in. thick, which can be economically removed without blasting.

"Solid rock" includes all rock found in ledges or masses of more than 1 cubic yard, which in the opinion of the engineer may be best removed by blasting.

It is evidently impossible to made such a classification quite exact, and it may probably be most truthfully regarded as only an approximate guide to the resident engineers.

The following note is appended to the specification:—"The company does not intend that the contractor shall do work at less than cost on account of hardness of the material. In determining classification, the element of necessary expense in removing the material should guide the engineer in his decisions." The existence of this clause saved some of the contractors from heavy losses on "cuts" where the "hard pan" was very hard. The company ascertained the actual cost of the work from sworn testimony, and made extra allowances to balance this cost with the payments.

The gradients on the West Shore Railway have been governed but little by the old principle of balancing the "cuts" and fills, and borrow-pits have been freely used all along the line. In locating the railway, cuts were avoided as far as this was compatible with a short route, and the greater part of the line west of the Hudson River is on embankment.

Two great advantages of this formation are (1) that snow is easily removed from the banks; and (2) that the roadway is thoroughly drained.

Most of the heavy banks have been deposited from side-tipping cars. These cars are first run out on light single-track trestlework erected on the original surface, and rising nearly to subgrade. After this trestlework has been filled in, the temporary track is shifted to the side till the double-track bank has been formed. The timber is left in the embankment and paid for by the company.

Near the city of Syracuse a bank about 30 ft. high, 2 miles long, and containing about 800,000 cubic yards, was formed in this way from two borrow-pits, one pit 1,000 ft. from the centre of the bank, the other 3 miles distant. Overhaul was not estimated in this case, and a sum of 40 cents per yard was paid for the excavation, haul and deposit of earth from the more distant pit, and of 35 cents per yard for earth from the other.

Steam-shovels were used, and averaged 600 cubic yards of material excavated per day of ten working hours. Small cars carrying 2½ cubic yards were employed; and two hundred of these handled by six 12 ton locomotives of 3 ft. gauge, kept three steam-shovels busy in the more distant pit with a haul of 2¾ miles. The bank referred to affords a good instance of the necessity of allowing a liberal percentage for contingencies in preliminary estimates. The ground crossed is at the side of a deep lake, and was probably once part of the lake bed. Borings to the depth of 60 ft. reached rock only at a few points, and showed soft marl underlying a thick peaty deposit. The region is a limestone one, and near the bank are numerous brine wells. One morning it was found that a part of the bank 200 ft. long, which was almost at full height on the evening before, had sunk 12 ft. into the ground carrying the formation trestlework with it. On one side the ground was heaved in a fissured bank 150 ft. long, 40 ft. wide and 7 ft. above its previous level. This was the first of three or four similar sinkings. At one place it seemed almost impossible to fill in enough material, and a trestle 300 ft. long, resting on piles, is now erected here. It is intended to fill this slowly after the railway is opened.

Most of the lower embankments have been made from small side borrow-pits and ditches, and, where possible, wheel-scrapers have been used as the cheapest means for shifting the material. In very favorable circumstances, 80 cubic yards per day of ten hours have been moved by each two-horse wheeled scraper, but 50 cubic yards is good work.

The scrapers are shovel-shaped pans, which are guided by hand, and filled by the pull of the horses. They are emptied by freeing the handles and allowing the scrapers to turn up as the horses go on. With most of the scrapers it is necessary for emptying that the point should catch the ground, but in some new forms this is not required. When the wheel scrapers are filled the load is lifted a few inches above the ground by an attached lever. For short hauls, "plain" scrapers with no wheels are sometimes used. Scrapers are useful in removing even hard pan or cemented gravel after it has been ploughed.

For finishing partly completed banks and for distributing ballast, a novel plough was sometimes used. The material is hauled on flat cars, and when the destination is reached the wheels of the cars are firmly braked and the material is unloaded by a large plough pulled along the cars by the locomotive. The plough is suported on small wheels, and is guided by a beam 6 in. by 8 in. in cross-section, bolted on the top of the cars. The rope used is a wire one, 1¼ in. in diameter. The ploughs are made in two forms, one form to throw equally on both sides, and the other to throw only to one side. The first form works very well indeed, but the great friction in the "side-ploughs" sometimes causes them to be thrown off the cars.

One of the resident engineers on the West Shore Railway devised a neat method for measuring tunnel work. He made a large wooden templet, shaped and divided like a common semicircular protractor, plumbed the center of this above the center line of the tunnel, recorded its height, and then measured from the center of templet to the points of the cutting, noting the angle shown by the number on the edge of the templet where the tape crossed it. In this way easily plotted notes were quickly and accurately got. The method, a direct application of polar co-ordination is evidently general, but is best suited to tunnels or cuts with steep slopes. In contouring for borrow-pit measurements or other purposes, American engineers take levels along two sets of lines dividing the ground into rectangles, varying in size according to the nature of the ground and the accuracy desired. Having these levels, contours are easily traced. Dumpy levels are almost unknown in the United States. "Y" levels are used, and these and the "transits" have, as a rule, erecting eyepieces, the small loss of light caused by the extra lens being disregarded as trifling.

Most of the levelling-rods have targets, which are used by the rodman on fine work, and always when the position of the instrument is changed.

For preliminary estimates of earthwork the volumes are obtained by scaling on the profile the cut or "fill" at the middle of each length of 100 ft., and taking the volume corresponding to the depth or height from a table of level cuttings and fills. To allow for compression in banks, or slips in cuts, and the inaccuracy of the method, which is one of defect, 10 per cent., is added to the volumes thus obtained. In the division-engineer's office at Syracuse, a combination of scale and table was devised which saved much time in the estimation of earthwork. A copy of the scale-table for 28 ft. formation is shown in Fig. 3. The point A is applied to the subgrade line on the profile, and then on glancing along the line on the scale which coincides with the original surface of the ground, the number of yards for the length of 100 ft. is seen. With this table two persons, one giving and the other writing down the quantities, can estimate earthwork very quickly.

For monthly partial estimates, by which advances to the contractors are adjusted, the borrow-pits and cuts are measured, the cross-sections plotted, and the volume of a section taken as equal to the product of its length, and the arithmetical mean of the areas of its end sections. Although this method gives results in excess of the true ones, it is generally used on account of its convenience, and is approved by statute for final calculations upon public works in New York State.

For final estimates of earthwork on the "West Shore Railway," the prismoidal formula is employed, when the difference in the end heights would cause a sensible difference between the results of the various methods. Much of the labor of calculation is saved by the use of tables

The author would here state that, at the risk of tediousness, he has quoted freely from the specifications of the West Shore Railway, which he believes are representative of the best American railroad practice.

When the bank has reached subgrade level, the sleepers are placed upon it, and the rails laid down and spiked before ballasting. The apparent object of this is to enable the ballast to be distributed from trains. The track is ballasted with a layer 18 in. thick, of clean stone, broken to pass through a ring 2½ in. in diameter, where such material is easily obtainable. Elsewhere, gravel free from earth, and stones larger than will pass through the 2½ in. ring is used. Experience on the Pennsylvania Railroad has shown that, except on hard bottom, broken stone alone is not so good as gravel alone for ballast, and that the best arrangement is a layer of broken stone on top of one of gravel. The ballast being brought forward, the rails and sleepers

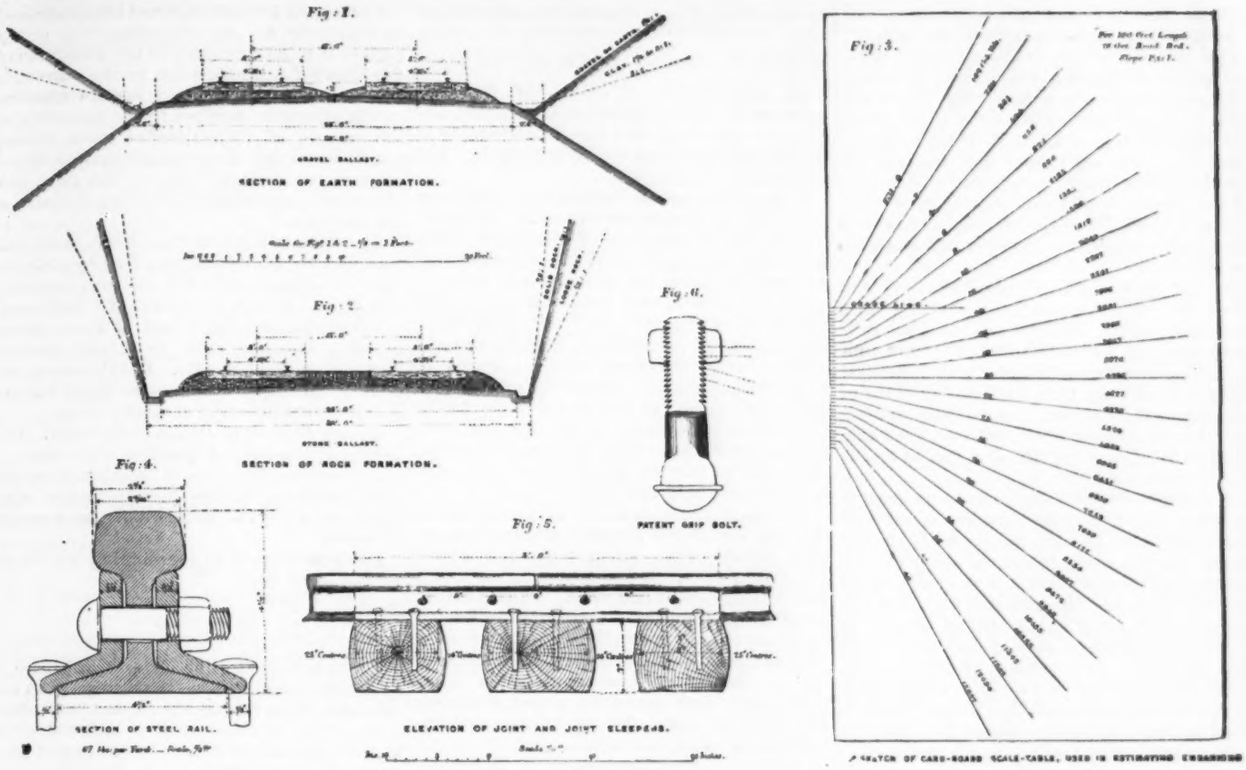


Fig: 7.

SEAM AND PLATE GIRDER DECK BRIDGES.

Fig: 8.

LATTICE DECK BRIDGES.

Fig: 9.

PLATE GIRDER THROUGH BRIDGES. ALSO SINGLE TRACK BRIDGES GENERALLY.

Fig 10.

FLOOR SYSTEM USED FOR LATTICE THROUGH AND PIN CONNECTED BRIDGES

NEW YORK, WEST SHORE & BUFFALO R. R.—DETAILS.—

are lifted by levers and jack-screws, and the ballast is packed and tamped under them until the line is brought to grade. The track-laying specifications forbid the rails to be lifted more than 6 in. at one lift, and require both rails to be lifted together at oppcsite points.

The sleepers, or, as they are called in America, the cross-ties, number not less than 2,816 to a mile of single line, and are specified to be peeled, sawn square at the ends, squared on two opposite sides, not more than 4 in. out of straight, 8 ft. long by 6 and 7 in. thick, and not less than 8 in. wide on each squared face. The kind of timber used varied much, and was generally that most easily delivered in the neighborhood where the ties were required. As far as convenient, however, the hard and soft ties were laid in continuous stretches of one kind. The timber was not creosoted or otherwise fortified against decay. The prices for each tie delivered were:

	Cents.
White oak, chestnut, or butternut	70
Cherry, and oak other than white	50
Yellow pine, hemlock, cedar, and larch	30

The rails are of steel, of the pattern called the Pennsylvania Railroad section (Fig. 4), and weigh 67 lbs. per yard. Flanged rails are universally used in America, and steel has now almost driven iron from the rail-market.

In September 1883, steel rails were sold at $37, or a little more than £8 per ton at the mill.

The rail joints (Fig. 5) are supported ones, and are made with angle fish-plates of unusually great length and weight. The plates are 36 in. long, and are spiked upon three crossties, so that the joint has a very solid foundation. The rails are so laid that the joint on one side of the track is opposite the middle of the length of the rail on the other side. There is much difference of opinion concerning the relative merits of suspended and supported joints.

On the New York Elevated Railway the joints are supported, and the engineer who designed most of the ironwork for these railways told the author emphatically that supported joints were the better for all railroads. On the New York Central Railroad some of the joints are supported and some suspended, but on all new work on the railroad the joints are now being made in the same way as on the "West Shore" Railway.

A simple form of check-nut for preventing joint-bolts from working loose has been found to answer well. In this, the screw of the nut starts exactly as in ordinary cases, but becomes gradually steeper on the sides of its grooves (Fig. 6.) The effect is to spring the threads of the bolt and secure an amount of friction which keeps the nut fast where it is first adjusted. The cutting of the varying screw of the nuts is effected by a modification of the screw-cutting lathe. The rails are fastened to each tie by two spikes, 6 in. long by ½ in. square, driven with 3 in. of "stagger" to lessen the chance of splitting, and to keep the ties at right angles to the track and preserve the gauge. To prevent the rails from "creeping," the edges of the fish-plates are notched to receive the edges of the spikes. This arrangement is recommended in preference to nicking the rail flanges.

The gauge is 4 ft. 8½ in. To allow locomotives with a long rigid wheel-base to pass easily round curves the gauge is widened ⅛ in. for a 2° curve, ¼ in. for a 4° curve and so on, ⅛ in. being added for every additional 2°. On curves, the lower rail carries the grade, and the superelevation is adjusted according to the following table:

Superelevation for	°	′	curve	Inch.
"	1		"	$\frac{1}{16}$
"	1	30	"	$1\frac{3}{16}$
"	2		"	$1\frac{1}{8}$
"	2	30	"	2
"	3		"	$2\frac{7}{16}$
"	3	30	"	$2\frac{13}{16}$
"	4		"	$3\frac{1}{4}$
"	4	30	"	$3\frac{5}{8}$
"	5		"	4
"	6		"	$4\frac{13}{16}$
"	7		"	$5\frac{3}{8}$
"	8		"	$6\frac{7}{16}$

The superelevation at the beginning and end of a curve is the same as at other points on it, and is tapered off on the tangents: for 1° curve in 50 ft.; for 2° curve in 100 ft.; for for 3° curve in 150 ft.; and for n° curve in $n \times 50$ feet.

The specifications are very explicit regarding the allowance to be made for expansion of the rails, and require the contractor to provide a proper supply of iron "shims" differing in thickness according to the temperature at which the rails are laid. The thicknesses stated are: for 80° Fanrenheit, ⅛ in.; 70°, ¼ in.; 60°, $\frac{3}{16}$ in,, 50, ⅜ in.; 40°, $\frac{7}{16}$ in.; and for 30°, ½ in. The track-layers, however, certainly did not carry an assorted pack of shims in cloudy weather, and the joints have no strikng uniformity in their clearances.

(TO BE CONTINUED.)

COL. MERRILL has ordered a survey of Little Chain and part of Grand Chain, Ohio River, as preclimnary to a general system of improvements to be begun at an early date, Capt. Golay has charge of the survey.

Recent Explosives and Improvements in their Manufacture and Use.

COMPILED FOR ENGINEERING NEWS BY GEO. J. SPECHT, C.E.

In *Dingler's Journal*, of Jan. 16, 1884, is a compilation, by O. Gutmann, of recently discovered explosives and the improvements in the manufacture and use of explosives. The following is an abstract:

E. Soulaville and R. Laligant, of Paris, suggested an explosive where nitro-glycerine is formed at the moment of explosion. This powder is made as follows: 36.06 parts of bisulphate of potassa or of soda, 28.60 parts of nitrate of potassa or of soda, and 9.20 parts of glycerine. The primer used with this explosive consists of from fifty to fifty-five parts of chlorate of potassa or of soda, and of fifty to forty-five parts of carbonic substances. Matter containing carbon is put into a concentrated solution of the above mentioned salts, the mixture is then dried and glycerine is added. The powder is then pressed into cartridges and wrapped in tarred paper.

Amidogene, invented by J. Gemperle, of Vienna, consists of 73 parts of nitrate of potassa, 8 parts of pulverized charcoal, 8 parts of pulverized bran, 10 parts of sulphur and 1 part of sulphate of magnesia. The nitrate of potassa and sulphate of magnesia are heated by steam or hot air at 140°, with the addition of one-third of their aggregate weight of water. After complete solution the other parts, previously mixed, are added, boiled for two hours at about 140°, then dried for five hours at 50° and pressed into cartridges with a pressure of 5,000 atmospheres (this pressure is unnecessary, one-tenth of it is sufficient). The patentee claims that the great pressure is without danger and that missed shots can be bored without risk. This, however, is not true. There is no perfectly harmless powder; although explosives with voluminous, elastic, cellulose ingredients can be submitted to to much stronger mechanical influences than black powder, explosions and accidents have occurred in consequence of carelessness and over confidence.

Safety-Powder, introduced by M. Koeppel, of Austria, according to *Dingler's Journal*, Vol. 246, is made in two numbers, No. 1 for hard, and No. 2 for soft rock. The composition is:

	No. 1.		No. 2.	
Nitrate of Potassa	35	parts.	42	parts.
Nitrate of Soda	10	"	22	"
Refined Sulphur	11	"	12.5	"
Wood-pulp	9.5	"	10	"
Chlorate of Potash	9.5	"	—	
Charcoal	6	"	7	"
Sulphide of Soda	4.25	"	5	"
Ferro-cynanide of Potassium	2.25	"	—	
Refined Sugar	2.25	"	—	
Picric Acid	1.25	"	1.50	"

These ingredients are finely pulverized, well mixed, and from 10 to 15 per cent. of water added until large lumps are formed which are then slowly dried.

The journal above mentioned also describes a powder invented by S. H. Hinde, of London. The following are the ingredients:

Nitroglycerine	64 %
Nitrate of Ammonia	12 %
Spermacite	0.25 %
Chalk	0.25 %
Charcoal	23. %
Bi-carbonate of Soda	0.50 %

In communications on matters pertaining to the Artillery and Engineer Corps, Vienna, 1883, Capt. Hess has published a series of general investigations on explosives. Among other things he says;

"Dynamite wrapped in parchment paper sweats nitroglycerine, if it is thawed after having been frozen. A cartridge of Guhr-dynamite, originally containing 71.63 % of nitroglycerine, was frozen and thawed three times; the surface was then found to contain only 67.52 %, and the whole cartridge carefully mixed, 71.42 % of nitroglycerine. After having again been wrapped up in parchment paper, and again frozen and thawed three times, the surface showed only 70.99 %. At the first trial the cartridge had been imbedded in *Keiselguhr*, and the surprising loss on the surface is to be attributed to the absorbtion of the sweated nitroglycerine by the surrounding *guhr*. The decrease in surface quantity can be otherwise ascribed to the shrinking of the volume of nitroglycerine when frozen, which may cause a partial separation of the oil from the capillary tubes of the *guhr*, and therefore a contraction towards the centre of the cartridge."

According to trials by Capt. Hess, Bickford's fuse can be made waterproof by careful rubbing with grease, or better still by repeatedly drawing it through a mixture of 6 parts wax, 1 part asphaltum and 1 part of resin, heated to 160°. The fuse must be a good one and burn off without sparks. If this cannot be done it cannot be made water tight for the spark breaks the outer shell of the fuse.

Quarry Blasting in France and Austria. The largest of the several quarries were those of Martinschizza, Zukovo and Prelucca. The rock was limestone, of the *Kasstformation*, with many caves; in the Prelucca it was compact however.

The formula used in determining the charge for the blast, was:

$$\frac{1}{2}\left[\pi\left(a+\frac{a}{3}\right)^2\right] b\, m = 4.188 a^3$$

Here a is equal to line of least resistance, b to height of bank above the charge, m to coefficient. This formula is correct only when $a : b :: 2 : 3$. It was desired to undermine the foot of the rocky slope, so that the rock should fall by its own weight.

The value of m was ascertained by trial for the different explosives used:

For *Diorrexin*, *Petralit* and *Holoxylin*, $m = 280$gr.
For Dynamite $m = 112$gr.

Of the above powders, *Diorrexin* was composed of:

Nitrate of potassa	42.78
Nitrate of Soda	23.16
Saltpetre	13.40
Charcoal	7.49
Beech-wood Sawdust	10.97
Picric acid	1.65
Water	0.55

Petralit is a powder similar to black-powder. *Holoxylin* is made as follows:

Nitrate of Soda	75.
Sawdust	15.
Charcoal	8.33
Ferro-cyanide of patassium	1.

Local circumstances decided the exclusive use of *Diorrexin*. It was modified slightly by the addition of soot which decreased its breaking powder, so that the percentage of small stone was decreased. Practical trials showed that the amount of *Diorrexin*, in kilograms, could be ascertained by $1.173\, a^3$.

The consumption of explosive per cubic metre (1¾ cu. yds.) of rock, was as follows:

	Trelucca.	Martinshizza.	Luckovo.
In drill-holes,	0.369 kilos.	0.278 kilos.	0.199 kilos.
In chambers,	0.290 "	0.485 "	0.522 "

The minimum charge in chambers, was 0.197 kilos. (0.433 lbs.) in Luchovo, and 0.232 kilos. (0.5 lbs.) at Trelucca. The chambers were made by driving a tunnel into the vertical rock-wall, and at the end a shallow shaft was sunk, at the bottom of which the powder chamber was excavated. On top of the powder from two to eight exploders were laid, consisting of bags of black-powder, with a dynamite cartridge in the centre. The wires were carried through wooden boxes or tubes out of the tunnel; the chamber was filled with straw, the shaft closed with masonry in cement and the tunnel filled alternately at 3 ft. distances with cement and dry masonry.

At Trelucca the result of a blast was:

Stone up to 0.25 tons = 0.057 cu. m.....	52.7 %
" from 0.15 to 1.5 tons = 0.577 cu. m..	26.9 %
" " 1.5 to 4 tons = 1.54 cu. m.	16.3 %
" over 4 tons	4.1 %

The largest charge used at Martinshizza, *i. e.*, 26,700 kilos. (58,740 lbs.) of *Diorrexin*.

For small chambers the process of corrosion with muriatic acid was used. A copper-tube, 27mm. wide, was put into the drill-hole, closely fitted at its mouth by hemp. Into this a rubber tube, 11mm. diameter, was placed connecting with a wooden box containing the muriatic acid. The acid was run into the drill-hole and left there for some time; then a new supply of acid was poured in, forcing the first dose, already weakened, out of the hole between the copper and the rubber tube, where it was caught for re-use. With one *litre* of acid a cavity 0.053 cu. metre was made. For a cavity of 1 cu. metre (1¼ cu. yds.) 18.87 *litres* (20 qrt's.) of muriatic acid were required, costing about 81 cents., and taking about 15 hours time. For smaller charges the gradual enlargement of the chamber by dynamite was most advantageous.

International Geodetic Association of Europe.

Verhandlungen der vom 11 *bis zum* 15 *September* 1882, *im Haag vereinigten permanenten commission der europaischen gradmessung.* Redigirt von A. HIRSCH und T. VON OPPOLZER zugleich mit dem general bericht fur die jahre 1881 und 1882. Berlin, *Reimer*, 1883. 6 + 155 p., 2 maps. 4°.

The proceedings of the annual meeting of the committee at the Hague, Sept. 11 to 15, 1882, have recently been published. The permanent committee consists of the following members: Lieut. Gen. Ibañez of Madrid, president; Dr. von Bauernfeind, vice-president; Dr. Hirsch of Neuchâtel, and Dr. von Oppolzer of Vienna, secretaries; Mr. Faye of Paris; and Major-Gen. Baulina of Florence. The delegates, eleven in number, represent most of the countries of Europe. Some invited guests also attended the meeting. The session was opened by the minister of state, Rochusson of Holland, who extended to the members a cordial welcome, which was responded to by President Ibañez.

The last meeting was held at Munich in 1880; but the commission resolved to omit the contemplated meeting for 1881, in order to give its members an opportunity to attend the Geographical Congress at Venice; the reports therefore submitted by the several representatives cover the work done, or in active progress, during the two years 1881 and 1882. Secretary Hirsch alludes to the loss sustained by the association since its last conference, in the death of Dr. Carl Bruhns, a member of the commission since 1864; in the death of Gen. de Ricci, one of the veterans of Italian geodesy; of Col. Adan of Belgium, and Professor Stamkart of Holland. The latter had shown that the mean level of the North Sea had not changed during the past hundred and fifty years with respect to the zero of the tide-gauge at Amsterdam. And, last, the association had to mourn the loss of Professor Plantamour of Geneva, whose labors in astronomy and physical geography are so well known, and to whose zeal the recent developments in levels of precision and the progress made in pendulum observations are so largely due.

The Italian commission was increased by Professor Fergola of Naples, by Professor Celoria of Milan, and by Lieut. Col. de Stefanis of Florence. Austria nominated Capt. von Kalmar and Professor Herr as commissioners; Holland completed its representation by Professor Schols of Delft; and Roumania sent Major Capitancanu. The honorary president and founder of the association, Major Gen. Dr. Baeyer, who, on account of ill health, was unable to attend, presented a report of the labors of the Geodetic institute of Prussia during 1881-82. He makes mention of the success of the experiments to determine the difference of temperature between the bars of platinum and brass of the Brunner base-apparatus by means of thermo-electricity. The researches for local deflection of the vertical were extended from the Harz to the shores of the Baltic and the North Sea with the result of proving it a region of predominating negative (A.—G.) deflection, varying between 4″ and 7″.

A list is presented of seventeen works published by the Institute during the interval. Several of these relate to levels of precision; and the pamphlet by Dr. Sadebeck, entitled 'Literature of the practical and theoretical measurement of arcs,' deserves special mention. In a discussion closing the first session, relative to the probable error in the assigned length of the pendulum, it was stated, that, to judge from the accord of the several swings, it might be estimated at about one micron, but that the oscillations of the pendulum support introduced a constant error, seriously influencing the accuracy of the result; the *direct* measure of the motion of the support entering the result being only a fortieth of the correction to be applied. By this method the accuracy is estimated at .01 mm. The proposition by Cellerier to swing successively on the same stand two pendulums of the same form and construction, but of very unequal weight, promises complete success towards correcting the defect in question; and the experiment is now being carried out. The second session was chiefly occupied with the reading of reports, and with a discussion respecting the value of the prismatic transit instrument. Six of these instruments employed in the Italian survey gave entire satisfaction, especially with regard to perfection of their images. The discussion was continued in the next session with remarks about the greater variability of the error of collimation in the prismatic transit; but its superiority in its low Y's over the common form of the instrument was recognized. In connection with the pendulum of reversion, Hirsch refers to the observations of Mr. C. S. Peirce of the U. S. coast and geodetic survey, at Geneva, Berlin, and Hoboken in America, which prove experimentally the therotical conclusion of the complete elimination of the resistance of the air by the use of Bessl's pendulum of reversion,—a conclusion indorsed by Ferrero from experiments made in Italy. In the fourth session, Villa ceau explains the construction of his new apparatus for the relative measure of the intensity of gravity and the commission recommends a direct comparison of the new apparatus and of the apparatus of Cellerier at a number of stations. A discussion followed on self-registering tide-gauges and river-gauges; Mr. Diesen stating that in Holland as many as sixty-four instruments were in operation, or being put to immediate use. Professor Nagel was elected a member of the permanent commission. In the following session the business programme for the seventh general conference of the European association for the measurement of arcs was formulated and adopted: viz.,—

1. Reading of the annual report of the permanent commission.

2. Reports of the progress of geodesy by the representatives of the several countries.

3. Reviews of the present of geodetic operations, subdivided as follows:—

Astronomical longitudes, latitudes, and azimuths (reporter Backhuyzen); Triangulations (reporter, Ferrero); Base-lines and base-apparatus (reporter, Perrier); Levels of precision (reporter, Hirsch); Tide-gauges (reporter, Ibañez); Gravity apparatus (reporter, von Oppolzer) Refraction (reporter, von Bauernfeind); Geodetic publications (reporter, Baeyer); Arc of the parallel in Europe (reporter, Faye).

The proposition to meet at Rome in October next is adopted, pending the favorable acceptation by the Italian-government.

The remaining part of the pamphlet is occupied with reports in detail of the progress made during the years 1881-82 in the countries represented. Their contents may be briefly summarized as follows:

Baden, Germany.—Levels of precision, and publication of the results of the Rhenish triangulation.

Bavaria, Germany.—Observations of terrestrial refraction, lateral and vertical; spirit-leveling, total development to date 2,578 km.; oscillations of the ground, and pendulum observations at the Bogenhausen observatory.

Denmark.—The fourth volume of the geodetic survey is promised towards the close of 1883.

France.—Connection by new triangulation of the base-lines of Melun and Perpignan; extension of the Algerian arc of the parallel into Tunis; measures of latitudes and of differences of longitude by telegraph. Volume xii. of the "Mémorial du dépôt de la guerre" is in press, and a table of logarithms of eight places of decimals is in preparation.

Hesse, Germany.—Levels of precision, mean error per km. equals 2.27 mm., from 32 differences in levels, connected by 14 conditional equations.

Holland.—Connection of lines of spirit-levellings with lines of adjacent countries; total length levelled, 283 km.

Italy.—The reconnaissance for the primary and secondary triangulation completed; geodetic levelling and tidal observations; determination of a latitude, an azimuth, and of several differences of longitude, by telegraph; comparative pendulum observations at Rome.

Austria.—Measure of astronomical latitudes; telegraphic determinations of differences of longitude; pendulum experiments; triangulations and astronomical work in general; occupation of points, and attempts of measures of angles, in the high Alps (among these Ankogl at an elevation of 3,263 m.; station Grossvenediger, of 3,659 m.; and of Grossglockner, of 3,798 m.); extension of triangulations in Bosnia Herzegovina, and Dalmatia; continuation of levelling operations in Austria proper, and in Hungary; observations of the intensity of gravity in the deep mine of Pribram. The work executed in this country is too extended and diversified to be given here in detail: it is graphically represented in a finely executed map in color-print.

Portugal.—Continuation of the triangulation and of tidal observations.

Prussia.—Revision and completion of principal lines of levels. The following important results are recapitulated: Atlantic higher than the Mediterranean from levels between Swinemunde on the Baltic, and Marseilles *via* Switzerland, 0.664 m.; Swinemunde to the Mediterranean, *via* Amsterdam and Ostend, 0.658 m.; and Santander to Alicante, in Spain, 0.662 m. The discussion of the tidal observations at Swinemunde showed no change in the relation of land and water during fifty-four years, and the mean level of the Baltic results with a probable error of ± 6.1 mm. The levellings to Constance and to Amsterdam are published, and the mean level of the North Sea is found 9.3 cm. above that of the Baltic. Computation of polar co-ordinates between geodetic and astronomical points. Determination of latitudes and azimuths. Maximum local deflection of the vertical reaches 6″.1 in the meridian and 12″.7 in azimuth.

Roumania.—Astronomical determination of positions.

Russia.—Connection of the triangulation of Bulgaria with that of Russia; astronomical determination of differences of longitude, connecting Bulgaria with Pulkowa, and Tiflis with the triangulation of the Caucausus; pendulum observations continued in the Caucasus; extension of the levels of precision (double measures) up to date, 4,123 km., and of single lines 618 km.

Saxony, Germany.—Publication of part I. of the third section of the astronomical and geodetic observations, comprising ten stations; recomputation of the base at Grossenhain.

Switzerland.—Additions to the triangulations to connect astronomically determined position and two new base-lines at Weinfelden (length 2. 5 km.) and at Bellinzona (length 3. 2 km.,) both measured with the Spanish apparatus of Ibañez; mean error of measure. $\frac{1}{2000000}$ for the Araberg base of 1880, $\frac{1}{3000000}$ and $\frac{1}{2000000}$ for the other two bases respectively. The coefficient of expansion of the iron bar of this apparatus had increased during twenty years $\frac{1}{75}$ part. After sixteen years of labor, the operations of levels of precision have been brought to a close.

Spain.—Determination of the length of the triangle side, Mulhacen-Tetica (82827.546 m. ± 0.115 m.), of the great quadrilateral concecting Spain with Algeria; adjustment of the triangulation connected with the base of Olite; junction of the Balearic Islands with the mainland, and observation of one side, of 240 km. in length (Desierto to Torrellas), during the night, by means of electric light; tidal and levelling operations; determination of the longitude between Madrid and Badajos; gravity measures at Madrid.

Wurtemberg, Germany.—Connection of lines of spirit-levellings with results of the Black Forest.

Belgium.—Comparison of results of the adjusted triangulation.

Norway.—Results of the difference of longitude of Christiania and Bergen, and of two base-lines with probable errore of $\frac{1}{1870000}$ and $\frac{1}{1500000}$ of their length; adjustment of a base-connection with a primary line involving fifty-three conditional equations.

In conclusion, Yvon Villarceau presents a paper on observations made at Paris with an isochronic regulator in connection with his new method for relative measures of gravity; the apparatus, however, had not yet been brought to the desired perfection. C. A. S.

Science.

THE contract for the iron work for the Chicago harbor, aggregating over 100 tons, has been awarded by the government to the Chicago Forge and Bolt Company, who have also secured similar contracts for some six or eight other harbors on Lake Michigan.

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" "	m	2.35	2.50

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Nationalities in Railroad Labor.

The national mutations in the common labor on public works in the United States would make a somewhat interesting study. In the early days of railroad building, in fact up to the year 1870, Ireland practically furnished all the labor, as it did and does now, the great majority of the contractors.

But to-day the Irish labor has almost disappeared from our railroads; it is supplanted by the Italian and Hungarian in the East, by the Swede in the West and further West still by the Chinese. The scattered representatives of Erin still at work are rather the battered wrecks of a once powerful class than types of that class.

There are several reasons to be advanced for this shifting of nationalities. First of all, Ireland is failing as a source of supply for muscle, and the best of the old stock have long ago graduated from the pit or dump and are themselves either superintendents or employers of labor. Native shrewdness united to long practical experience with the manifold uses of the pick and shovel eminently fits the Irishman for the duties of a builder of public works, and in this direction many colossal fortunes have been amassed in the golden days of contract work.

Other fields of labor more congenial and more lucrative have opened to them; they seem to prefer the larger cities and figure extensively in politics. And more than any other nationality they have literally made this last a profession: the Mac's and the O's that dot the lists of the municipal authorities of all our great cities prove their success in obtaining office, if it does not always bear witness to their fitness for the same. The Irishman of the better class is a born leader of men, and the blood of the race runs in the veins of many of the world's most eminent statesmen and bravest soldiers. But unfortunately, the class referred to above is not always recruited from the better element, and the ways of the political "worker" are not to be commended.

But to return to our subject, another and the powerful factor in driving the Irishman from our public works has undoubtedly been the greatly increased importation of cheap continental labor. The Swede came first, but agriculture has superior attractions for this class and they soon abandon the railroad for the farm. Then followed a swarm of Italians, who, accustomed as they were to small pay and meagre fare at home, found comparative wealth in the, to them, extravagant hire in the States. Later still the sturdy Hungarian has emigrated to swell the ranks of our unskilled labor, and he is generally crowding out even the Italian. Chinese labor has been confined solely to the Pacific coast, and the Irishman in politics there, has taken the adjustment of this matter into his own hands by forcing legislation against them. We do not refer to negro labor because that has always prevailed in the South, and their appearance upon northern roads is the simple result of the rending of their chains in 1861-65. Nevertheless the freedom of the negro has thrown open a source of labor supply on public works that did not exist prior to 1860, and has had an important bearing upon the change in the class of labor since that time.

As to the national and race characteristics of the different classes of laborers referred to, opinions differ. The Irishman of the olden time was undoubtedly the best man for the work in land, and as long as an abundant supply of good material existed, the condition of affairs could hardly be improved upon. With all his failings, his peculiar affinity for whiskey and his fondness for handling "a bit of a stick," Pat was a good fellow and a good worker. But in time, the good men were sifted out and the bad seemed to grow worse and a change was necessary.

Along with the deterioration of the labor and the demand for higher wages for less efficient work, came the temptation of the cheaper labor of the Continent, and this latter element was introduced about 1870. The Italians were few in numbers at first and, hanging together in gangs had many a battle with the outraged Irishmen who resented the cutting of wages by the foreigners. But the newcomers, being generally sober and industrious and giving full return for the money paid them, soon won the favor of their employers and their numbers rapidly increased. As a laborer the Italian is clannish and any interference with the supposed rights of one man generally means the striking of the entire gang, They are revengeful and blind and unreasoning in their anger, and in their demands, hence are rather difficult to handle. Their sole aim apparently is to accumulate sufficient money to enable them to return to their sunny Italy, and there end their days in comfort on the interest of a couple of thousand of dollars saved, They very rarely become citizens.

The Hungarian is preferred to the Italian on acconnt of his greater tractability, his solid working capacity and his lack of desire to return to his home: he generally comes to stay. They are a drinking race but seldom become a nuisance to the community, and when drunk would rather hug each other than fight.

The negro in the north is usually found in tunnel-work; they make the best of miners when once trained, and sing as they work, often under circumstances that would sorely test the patience and good-humor of the white man. But the darkey is fond of basking in the sun, an old time habit he can not quite conquer, and a little driving is necessary to get him out to his work; once in the pit or in the tunnel he does good service. They are a faithful, confiding class and will follow a contractor who treats them well, for years. Their besetting sins are improvidence and the natural fondness for rest referred to.

Of the characteristics of the Chinese laborer we can say nothing from personal observation, saving that rumor speaks well of them as to the service rendered.

PERSONAL.

ISAAC NEWTON, MEM. A. SOC. C. E. Chief Engineer of the Croton Aqueduct and of the Department of Public Works of this City, committed suicide at his rooms on Union Square and 15th St. on Thursday morning. Chronic dyspepsia and worry, causing temporary insanity are given as the cause of the act. From the *Sun* of yesterday we quote:

ISAAC NEWTON was the son of a well-known Hudson River steamboat owner and Captain of the same name, who was a brother of Gen. Newton of Hell Gate fame. One of the well-known Hudson River boats was named after the father. The son was born in 1838. As a lad he went up and down the river on the steamboats, and showed a decided bent for engineering. He was graduated at the New York University as a civil engineer when about twenty years old, and at once entered the Delamater Iron Works, where he served an apprenticeship, and learned the practical work of a mechanical engineer, and studied the theory of mechanical engineering at night. When the war of the rebellion broke out, he entered the navy with the rank of First Assistant Engineer. In the mean time he had made the acquaintance and gained the friendship of the famous inventor, Captain Ericsson, and had seen and approved the plans of the original Monitor. This ship was to make a revolution in naval warfare, and Engineer Newton was the only one in the navy who endorsed the ship. When practical work began on her Mr. Newton was, at the request of the inventor, detailed to assist in superintending her construction. When she was completed he sailed in her as her chief engineer, and as such worked her machinery while she fought the Merrimac. His coolness and skill and good judgment during the fight were mentioned in the report of her captain. Detailed drawings of the Monitor hung on the walls of Mr. Newton's bedroom yesterday.

Sometime later he was sent to New York and put in charge of the office that superintended the construction of ironclads for the navy. He was a severe critic of the antiquated in the navy, and in consequence ran foul of so much opposition that he resigned his commission. It is conceded that at that time he was the best informed man in the country on ironclads.

For a time he was in the service of a Pennsylvania coal company. Then he assisted in the construction of the Stevens Battery. In 1871 he was made the principal assistant to Gen. McClellan, who was then the engineer of the dock department. He planned and built the big one-hundred-ton derrick which belongs to the department, and he also superintended

the construction of the masonry of Pier 1. North River. On March 15, 1881, he was appointed by Commissioner Hubert O. Thompson to be Chief Engineer of the Croton Aqueduct. Since that time, in addition to his regular work he had planned the Quaker Dam and superintended the surveys for the new aqueduct. The present or Mill Creek route was decided on by the Mayor's Commission against his judgment. It is said by his associates that his work in connection with the new aqueduct is sufficient to establish his reputation as an engineer.

Experiments on the Flow of Water.

At the meeting of the American Society of Civil Engineers, Sept. 3, 1884, a paper by Edmund B. Weston, M. Am. Soc. C. E., was read, giving the description and result of experiments on the flow of water through a 2½ inch hose and through nozzles of various forms and sizes; also giving the results of experiments as to the height of jets of water. The experiments were made at Providence, R. I. The water was taken from a hydrant to the head of which was attached couplings holding two pressure gauges, and from the couplings the hose extended to a tank holding 2,100 gallons, so arranged as to measure accurately the time and amount of delivery of water by the hose. Different lengths of hose were used. The experiments resulted in the following formula for flow from coupling.

1. For hose between 90 and 100 feet in length and where great accuracy is required.

$$V = \sqrt{\frac{2gh}{\left\{1. - .0256d^4 + \left(.0087 + \frac{.0504}{\sqrt{v}}\right).1228d^4l\right.}}$$

2. For all lengths of hose—a reliable general formula.

$$V = \sqrt{\frac{h}{.0155463 - .000398d^4 + .0000362962d^4l}}$$

v, being velocity of efflux in feet per second.
h, head in feet indicated by gauge.
d, diameter of coupling in inches.
l, length of hose in feet from gauge.
V, velocity in 2½ inch hose.

Forty-five experiments were made on ring nozzles resulting in the following formula.

$$f = .001135v^2$$

f, being loss of head in feet owing to resistance of nozzle and v, the velocity of the contracted vein in feet per second.

Thirty-five experiments were made with smooth nozzles resulting in the following formula.

$$f = .0009639v^2$$

f, being the loss of head in feet owing to resistance and v, the velocity of efflux in feet per second.

Experiments show that a prevailing opinion is incorrect that jets will rise higher from ring nozzles than from smooth nozzles.

Box's formula for height of jets of water compares very favorably with experimental results.

SEPTEMBER, 17, 1884.

A paper giving results of experiments with rain gauges differently located and experiments as to the rates of depth of snow to the depth of same when melted, by Edmund B. Weston, M. Am. Soc. C. E., was read. It was found that in a number of experiments extending over considerable periods of time a gauge 14 feet 8 inch above the ground collected 9 per cent. less water than one 8 inches above the ground; that a gauge 22 feet above the ground collected 10½ per cent. less water than one 8 inches above the ground that a gauge 3½ feet above the ground collected 6 7/10 per cent. less water than one 3 inches above the ground.

The average result of 53 experiments at one point was that the depth of snow was 6 25/100 times the depth of the same when melted, and the average result of the same number of experiments at another point gave 6 5/10 times the melted depth.

Connecticut Civil Engineers and Surveyors Association.

The First Annual trip of the Conn., Civil Engineers and Surveyors Association took place from New Haven, Sept. 5th, on the oyster steamer Ivernia.

The following members and visitors were on board.

B. H. Hull and Mrs. Hull, Mr. Peck and Chas. Dimond of Bridgeport; S. E. Barney and Mrs. Barney, S. Butler and Miss Butler, D. C. Sanford, J. R. Patterson, G. H. McMillan, Arthur Moore and F. H. Smith of New Haven; H. G. Loomis, — Loomis, C. H. Bunce and C. B. Ball of Hartford; F. F. Weld, and H. J. Kellogg of Waterbury; T. H. McKenzie and J. M. McKenzie of Southington, D. S. Brinsmade H. S. Whipple of Birmingham; W. E. Pettee and Mrs. Pettee of Lakesville. E. P. Augur of Middletown, E. B. Chandler, San Antonio, Texas, C. E. Chandler of Norwich.

The day on shore was the hottest of the season, but on the sound the temperature was delightful.

During the trip Mr. D. C. Sanford Assistant Engineer to the Connecticut Shell Fishery Commission, illustrated with sextants the methods used in surveying the oyster grounds and setting buoys to mark the boundaries of the different tracts. Nearly all present were landsmen, but a little practice with the sextants soon made proficient Hydrographic Surveyors of them all.

Mr. Sanford exhibited and explained maps and note books which were novel and interesting.

He also described the oyster industry and all received new and interesting ideas regarding it. The dredge was thrown over, and the oysters taken in were sampled by the company.

Upon the shells brought up were plenty of very young oysters, something most of the party had never seen before.

Mr. Sandford had with him a dry shell on which he had counted the young oysters, and had calculated that should they all reach maturity they would make 32½ bushels of oysters.

The dredge also brought up jingles, winkles and a variety of, to landsmen, odd looking objects.

E. B. Chandler, C. E. of San Antonio, Texas, gave an interesting account of his experience as a County Surveyor in Texas, including a description of the Texas land system.

F. F. Weld, City Engineer gave interesting details connected with the sewerage of Waterbury.

Various and sundry problems in sewerage, water-supply, railroading, etc., were discussed and experiences ludicrous and otherwise were recounted in groups here and there.

If the author of the future handbook for City and Borough Surveyors had heard all the questions asked, it would have given him a fair idea of the proper scope for his book, and had he heard all the answers, it would, I think have assisted him in his work.

A sea food dinner was discussed at Dorlon's Point.

The secretary in behalf of the author presented the association with a copy of Fanning's Hydraulic and Water Supply Engineering.

Owing to unanticipated delay in reaching the Point the reading of papers by Messrs. Hull, Augur and Pettee was postponed to the next meeting.

The company left Norwalk on the evening trains. C.

CORRESPONDENCE.

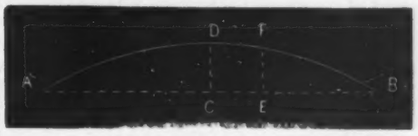
Calculation of Ordinates.

Special Correspondence Engineering News.

BOSTON, Sept. 22, 1884.

EDITOR ENGINEERING NEWS:—In the NEWS of Sept. 6, I was glad to see an article on the calculation of ordinates. But in many cases, the field book may not be handy and then it is too long to get the middle ordinate and from that get any other that may be required. Below you will find a rule which is simple and practically correct when the chord is short in comparison with the radius.

To find the ordinate EF, multiply the length AE of that portion of the chord which is on one side of the ordinate, by the remainder of the chord EB, and divide by *twice* the radius.



Taking the example used by Mr. Roberts, of a 1° curve, required the ordinate at a point 40 and 60 ft. from the ends of a 100 ft. chord

$$EF = \frac{40 \times 60}{2 \times 5730} = \frac{2400}{11460} = .209$$

This rule will apply whether the chord be 100 ft. long or any other length. Probably many of your readers are familiar with this rule but, I have found so many engineers to whom it is new, that I take the liberty of sending it to you. Yours truly,

H. C. KEITH.

Hydraulic Placer Mining.

Special Correspondence Engineering News.

SWAN, SUMMIT CO., COL. Sept. 12, 1884.

EDITOR ENGINEERING NEWS:—The work of "Jack Frost" in covering our hydraulic pipe and nose with ice, and the miners scraping it from their shovel handles, reminds me of his namesake Geo. H——; this is in the morning, the afternoon will be more like weather in the United States. The system of placer mining adopted is new in Colorado, though it has been in use for some time in California; some points have been developed here which may be of interest to your readers.

In 1871, the writer made use of an annular jet from the head given by a dam to drain a coffer-dam below. Had previously used a center jet as a circulating pump for a suface condenser. The annular jet was found so simple and efficient that its use has been continued in such form as circumstances made most convenient.

The Ouray Discovery and Mining Co., owning a large gold placer in which the grade gave no place for dumping ground, the plan of elevating the gravel from a pit sunk to bed rock, by means of this device, was suggested and acted on. The lateness of the season, snow not being off till the middle of June, made it impracticable to finish the ditch to the desired point, and it was determined to try the experiment at a locality where the ditch was 105 ft. above the surface of the placer. The California practice gives a lift of 10 to 12 ft. per 100 ft. of head, and our plant was designed for this, a small elevator (8 in.) being made for experimental work. This elevator is simply a cast-iron mouth piece expanded to about twice the area of the 8 in. wrought-iron pipe to which it is attached; a 2¾ in. nozzle is placed at the mouth giving a jet straight and central with the 8 in. pipe; this is lengthened with 9 in. pipe and set in a pit 20 ft. below the washing flume. The effective head at the nozzle is probably about 120 ft. the lift about ⅛ of the head, the area of the jet a little over ⅛ of the discharge pipe.

When emptying the pit the water rises about a foot above the mouth of the 9 in. pipe; when emptied so that air can enter with the stream from the giant, (and the cover taken from the flume,) stones as large as can pass from the pipe are projected from 20 to 30 ft. from its mouth; the pipe is placed at an inclination of about 40°.

The action of the plant shows that with a working size of elevator (12 in. or larger) bed rock can be reached and successful placer mining done in localities where it was formerly deemed impracticable, and that it can be done where the effective head of water is less than desirable, by using a correspondingly larger quantity of it.

G. W. PEARSONS.

AN investigation into the causes of a scarcity of water in the Third and Fourth wards of Philadelphia, showed that a large sugar refinery in that section was absorbing the entire supply and paying nothing for it.

Irregularity in Railroad Building, and Recent Business Depressions,*

"The statistics of the iron and steel manufacture and of railroad building in the United States offers a fruitful field for the student of economic science. The story of industrial developement told by these statistics for the last 20 years is probably without a parellel in industrial history of the world. Whether viewed from the standpoint of the political economist, who wishes to find therein support for his own peculiar views on the evils or benefits of the tariff; from that of the patriot, who rejoices in the vast increase of the Nation's wealth shown by the figures; from that of the optimist in social science, who sees in them the evidence of advance in civilization and in comfort of the race, or of the pessimist, who sees in them only the "rich growing richer and the poor growing poorer," or from that of the student of finance, who sees in them the causes or effects of monetary crises, their contemplation cannot fail to prove instructive, if not even startling.

I present herewith a table of condensed statistics of the production and average prices of iron and steel products, of immigration and of railroad building in the United States for each year from 1860 to 1883, and also a plotted diagram made from the figures, by the graphical method, in which the story of the figures may be read more plainly. The figures are taken chiefly from the admirable reports of the secretary of the American Iron and Steel Association, Mr. James M. Swank."

In referring to the table (See p. 153) Mr. Kent virtually repeats the data there set forth but draws deductions from it showing that the increase of production of pig-iron, iron and steel rails etc., is nearly coincident with increase in price. The periods of large and small immigration also closely coincide with the ratio of railway mileage.

In reviewing the interval of 24 years, as plotted on the diagram, the author divides this time into four periods:

First.—The period of moderate developement from 1860 to 1868, inclusive, in which the production of material and immigration increased at a comparitively even rate. The fluctuation in prices, being in currency, are changeable to the influence of gold, rather than to varying supply and demand.

Second.—The first period of violent developement, 1869 to 1873, inclusive, in which an enormous increase is noted, the railway mileage rising to 7,379 miles in 1871, and 437,750 emigrants arriving in 1872. The general production bore like proportions.

Third.—The period of depression, 1874 to 1878, inclusive, characterized by small railway mileage, decreased production and prices. In this period the developement and cheapening of the Bessemer process increased the production of steel rails, and the making of iron rails decreased in even a greater ratio.

Fourth.—The second period of violent developement, from 1879 to 1883, inclusive, with the general "boom" recorded for the years 1869-1873.

Mr. Kent continues by saying:

"Without further preliminary remarks, the following proposition may be stated, which I think may be proved from the statistics: Irregularity in railroad building is the chief proximate cause of both the depression of business of 1873-78 and that through which we are now passing.

Appealing to the statistics in support of this proposition, we see that in 1871 there were 7,379 miles of railroad built, which number was not again equaled prior to 1881. In the same year 775,000 tons of rails were made in the United States, and 566,000 tons imported. It is a matter of history that the demand for iron in 1871-72 caused a rapid increase in the number of iron works and in the capacity of those then existing. The number of blast furnaces increased 15 per cent. from 1872 to 1874, and the pig iron capacity probably 50 per cent. In 1872, although there were not so many miles of railroad completed as in 1871, the rail production increased 225,000 tons and the pig-iron production 900,000 tons, or nearly 50 per cent. of the product of 1871. Let us now compare the figures for 1872 with those of 1875:

Year.	Miles railroad built.	Total rails made in United States	Rails imported.	Pig iron made.	Pig Iron.	Iron rails.	Steel rails.	Immigration.
1872.....	5,878	Tons. 1,000,000	Tons. 530,000	Tons. 2,854,559	$48\frac{7}{8}$	$85\frac{1}{2}$	9	437,750
1875.....	1,713	792,000	19,498	2,266,581	$35\frac{1}{4}$	$47\frac{1}{2}$	68¾	151,301
Decrease.	4,135	208,000	511,392	567,977	$23\frac{3}{4}$	$37\frac{1}{2}$	43¼	286,519

Deficiency..... 5,878 miles railroad, at say..... $80,000 $285,000,000
1,713 miles railroad, at say..... 30,000 51,390,000
$242,510,000

"At the very high prices for iron rails, labor, etc., in 1872, probably $50,000 per mile is not too high a figure at which to estimate the cost of building railroads at that date.

1872—1,000,000 tons rails, at, say, $85	$85,000,000
1875—792,000 tons rails, at, say, $47	37,224,000
Difference	$47,776,000
1872—530,000 tons rails, imported at $85	45,050,000
1875—19,000 tons rail, imported at $47	893,000
Difference	$44,157,000
1872—2,850,000 tons pig iron, at $49	$139,650,000
1875—2,226,000 tons pig iron, at $25½	56,763,000
Difference	$82,887,000

There were probably at least $200,000,000 less actually paid as the cost of building, railroads in 1872 than in 1875. The investment in railroad stocks and bonds probably decreased more than double this amount, since in 1872 railroads were notoriously built on 'watered' bonds, in which enormous profits were made by brokers and projectors."

The author contends that although the majority of the railways built in 1872 went into bankruptcy soon after, not a dollar of the actual cost was lost except to the original investors.

"It was merely redistributed to other holders—to the laborers who graded and tunneled the roads, to the woodchoppers who cut the ties and the timber for cars and for stations; to the men who laid the ties and the tracks and built the cars and the stations; to the proprietors of the rail mills, who in turn distributed it to their workmen, and to the proprietors of the blast furnaces. Every iron miner and every coal miner in the country received some of the benefit of the distribution of the vast amount of money to build the railroads, in the steady demand for his labor and in increased wages. Existing railroads felt the benefit in freighting supplies for the new roads. The laborers of every kind, from the miner who provided the raw material for the railroad to the artist who decorated its palace cars, received the benefit of steady employment and high wages, which wages they in turn distributed to every quarter of the globe in payment for every necessity and luxury of life, causing such a demand for luxuries especially as had never before been known. The unusual distribution of money consequent upon building railroads in 1871 and 1872 had an effect like that of Government contracts during the war—it insured the prosperity of nearly every branch of industry. This prosperity in turn begat a demand for labor, so great that 850,000 immigrants came within two years, and they were all absorbed without apparently causing any surplus of labor. Such was the history of the 'flush times' immediately preceding the panic of 1873."

Taking another view of the picture, capitalists, in Europe as well as America, paid out in one year about $300,000,000 for building railroads in the United States. Of this amount probably more than one half was paid for labor and material, the remainder going to other capitalists, to land, mine and mill owners, and to bankers and speculators in bonds. But the latter half was again redistributed and "the end of its influence no man can tell."

As a result of this "prosperity," wages were high, labor was in demand, mills and manufacturies were busy in meeting the consumption and in fitting out still other factories, furnaces and mines, building and opened to meet the demand and in time to become competitors of their creators. This was especially true in 1881, when many machines were imported from England at great expense, simply because they could not be obtained in this country in the time required. The continuance of such a season of prosperity meant the continued yearly expenditure of $300,000,000 in railroad building, or rather a geometrical increase in this amount, and if this rate was no greater than the increase in population and wealth of the country all would be well, but if it goes at a faster rate, it must sooner or later meet a check.

As a matter of fact the pace was too fast, and the investment did not continue at the same rate in 1873 as in 1871 and the reproduction of manufactories was naturally checked. In 1875 the expenditure for railways was $200,000,000 less than in 1872, and every class of society felt this enormous withdrawal of currency. England's pig iron production fell off 10 per cent. in two years and in England and the United Strtes iron and steel touched the lowest prices ever recorded.

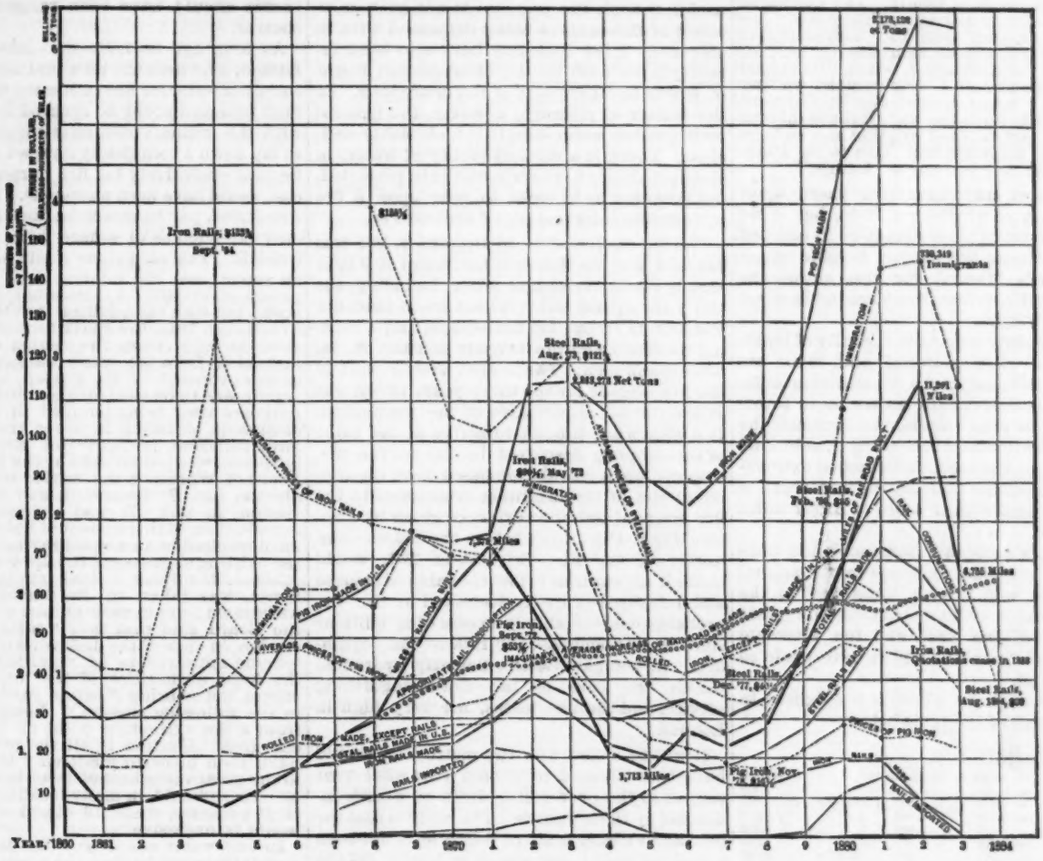
"The years of depression, 1874-78, were remarkable for another event in the history of the country more important than the depression itself—namely, the great flow of emigration from the Eastern and into the Western States. This was to a large extent caused by the depression. The men thrown out of employment by the stoppage of railroad building, and by the stoppage of building and of running of furnaces, mills and machine shops, took the advice of Horace Greely and "went West." Then ensued such a developement of the farming interest as had never before been known. The new railroads, in the hands of receivers as they were, and the grave of hundreds of millions of dollars thrown away by reckless investors, the railroads whose premature building caused the depression of business now proved the greatest blessing to the country and made a quick recovery from the depression possible. They opened up the Western country, carried the laborers from the East and enabled them to become the prosperous farmers and the builders of cities of the far West. Then, as immigration from Europe diminished and the surplus labor of the East became absorbed into the farming population of the new West, the country seemed to be embarking upon a prolonged season of prosperity, in which conservatism and caution of business men, and low prices, were to be the characteristics.

In 1878 the country was prosperous, iron had reached its lowest price, the production was increasing and railway building was progressing steadily and immigration was on the increase. But in 1879 the "insanity of capital" again broke out at fever heat.

"Projected railroads where they were not needed, created an artificial demand for iron, advanced the price of pig iron from $16.50 in November, 1878, to $41 in February, 1880; iron rails from $34 in January, 1879, to $68 in February, 1880, and steel rails from $41 in December, 1878, to $85 in February, 1880, in each case doubling or more than doubling the price in a few months. Such was the "boom" of 1879, which caused the building of furnaces and mills the opening of mines to supply the vastly and suddenly increased demand for iron. In February, 1880, the "boom" culminated in the above high prices, which rapidly fell until July, when they sold pig iron $23.50, iron rails $45 and steel rails $62.50. But the "insanity of capital" did not cease from its fever with the the collapse of the boom. It had only fairly started in its career of railroad speculation, and the high prices of steel rails for two years after the boom, instead of checking railroad building, seemed to act as stimulus. The history of 1869-73 repeated itself in 1879-73, as shown in the following figures.

*Condensed from a paper read by Wm. Kent before the Section of Economic Science and Statistics of the Am. Philadelphia

DIAGRAM SHOWING RAILROAD CONSTRUCTION, RAIL AND IRON PRODUCTION, PRICES, IMMIGRATION, ETC., FROM 1860 TO 1884.


Iron Rails, $122½, Sept. '64
$130½
Steel Rails, Aug. '73, $121
Iron Rails, $68½, May '73
7,379 Miles
3,713 Miles
6,755 Miles
Steel Rails, Feb. '76, $66
Steel Rails, Aug. 1884, $39
Pig Iron, Sept. '73, $37½
Pig Iron, Nov. '78, $16
Iron Rails, Quotations cease in 1883
AVERAGE PRICES OF IRON RAILS
AVERAGE PRICES OF STEEL RAILS
AVERAGE PRICES OF PIG IRON
IMMIGRATION
IRON RAILS MADE
STEEL RAILS MADE
RAILS IMPORTED
PIG IRON MADE
ROLLED IRON MADE, EXCEPT RAILS
TOTAL RAILS MADE IN U.S.
PRICES OF PIG IRON
Year, 1860 1861 2 3 4 5 6 7 8 9 1870 1 2 3 4 5 6 7 8 9 1880 1 2 3 1884

TABULATION OF STATISTICS PLOTTED ON DIAGRAM.

Year.	Miles of railroad built.	Iron rails made in United States. Net tons.	Steel rails made in United States. Net tons.	Total rails made in United States. Net tons.	Rails imported. Net tons.	Approximate rail consumption. Net tons.	Pig iron made in United States. Net tons.	Rolled iron, except rails, made in United States.	Prices per ton of 2240 pounds. Pig iron.	Iron rails.	Steel rails.	Pig iron produced in Great Britain. Tons of 2240 pounds.	Immigration. Number of persons.	Year.
1860...	1,846	205,038	None.	205,038	.....	.....	919,770	.....	$22¾	$48	.....	3,826,752	.....	1860
1861...	651	189,818	None.	189,818	.....	.....	731,544	.....	20¼	42½	.....	3,712,390	89,724	1861
1862...	834	213,912	None.	213,912	.....	.....	787,662	.....	23⅞	41¾	.....	3,943,469	89,007	1862
1863...	1,050	275,768	None.	275,768	.....	.....	947,604	.....	35¼	76⅞	.....	4,510,040	174,524	1863
1864...	738	335,369	None.	335,369	.....	.....	1,135,996	536,958	59¼	126	.....	4,767,901	193,195	1864
1865...	1,177	356,292	None.	356,292	.....	.....	931,582	500,048	46½	98⅜	.....	4,819,254	247,453	1865
1866...	1,716	430,778	None.	430,778	.....	.....	1,350,343	595,311	46⅞	86¾	.....	4,523,897	314,917	1866
1867...	2,449	459,558	2,550	462,108	163,049	625,157	1,461,626	579,838	44½	83½	.....	4,761,023	310,965	1867
1868...	2,979	499,489	7,225	506,714	250,081	756,795	1,603,000	598,286	39¼	78⅞	$158½	4,970,206	289,145	1868
1869...	4,615	583,936	9,650	593,586	313,163	906,749	1,916,641	642,220	40⅝	77¼	132¼	5,445,757	385,287	1869
1870...	6,070	586,000	34,000	620,000	399,153	1,019,153	1,865,000	705,000	33¼	72¼	106¾	5,963,515	356,303	1870
1871...	7,379	737,483	38,250	775,733	566,202	1,341,434	1,911,608	710,000	35½	70⅜	102½	6,627,179	346,938	1871
1872...	5,878	905,930	94,070	1,000,000	530,850	1,530,850	2,854,558	941,992	48⅞	85½	112	6,741,929	437,750	1872
1873...	4,107	761,062	129.015	890,077	258,772	1,148,849	2,868,278	1,076,368	42¾	76⅔	120½	6,566,451	422,545	1873
1874...	2,105	584,469	144 944	729,413	108,312	837,695	2,689,413	1,110,147	30¼	58¾	94¼	5,991,408	260,814	1874
1875...	1,713	501,649	290,863	792,512	19,448	811,960	2,266,581	1.097,867	25½	47¾	68¾	6,365,462	191,231	1875
1876...	2,712	467,168	412,461	879,629	287	879,916	2,093,236	1,042,101	22¼	41½	59¼	6,555,997	157,440	1876
1877...	2,281	332,540	432,169	764,709	35	764,744	2,314,585	1,144,219	18¾	35¼	45½	6,608,664	130,502	1877
1878...	2,687	322,890	550,398	882,685	10	882.695	2,577,361	1.232,686	17⅛	33¾	42¼	6,381,051	153,207	1878
1879...	4,721	420,160	683,964	1,113.273	44,147	1,157,420	3,070,875	1,627,324	21½	41¼	48¼	5,995,337	250,565	1879
1880...	7,174	493,762	954,460	1,461,837	290,689	1,752,526	4,295,414	1,838,906	28½	49¼	67½	7,749,233	593.703	1880
1881...	9,789	488,581	1.330,302	1,844.100	386,321	2,230,421	4,641,564	2,155,346	25⅛	47⅞	61⅛	8,377,364	720,045	1881
1882...	11,591	227,874	1,438,155	1,688,794	224,127	1,912,921	5,178,122	2,265,957	25¼	45½	48½	8,493,287	730,349	1882
1883...	6.755	64,954	1,286,554	1,360,694	38,977	1,399,671	5,146,972	2,283,920	22⅜	Not quoted	37¼	8,490,224	570,316	1883
	93,017													

Two Periods of Moderate Railroad Building.

Year.	Miles.	Year.	Miles.
1864	738	1874	2,105
1865	1,177	1875	1,713
1866	1,716	1876	2 712
1867	2,449	1877	2,281
1868	2,979	1878	2,687
Total	9,059	Total	11,498

Two Periods of Rapid Railroad Building.

Year	Miles.	Year	Miles.
1869	4,615	1879	4,721
1870	6,070	1880	7,174
1871	7,379	1881	7,780
1872	5,878	1882	1,591
1873	4,107	1883	6,755
Total	28,049	Total	40,000

The statistics of the iron production also show that the production of rails more than doubled from 1871 to 1881. Importation of rails increased in the same year from 10 tons to 386,000 tons. Pig iron production more than doubled from 1878 to 1882, and immigration increased from 130,000 in 1877 to 730,000 in 1882.

It is estimated that only 4,400 miles of railroad will be built in 1884, representing, at 30,000 per mile $120,000,000. This means the scaling of all classes of labor connected with railways, and insufficient work for our furnaces and mills which have a capacity of at least 12,000 miles of railway per year. All this because too many miles of railroad were built in 1879-83 and too few will be built in 1884-88 to furnish employment to men and mills.

A still clearer conception of the effect of diminishing the annual cost of building railroads by the sum of $200,000,000 may be gained by another brief calculation. If the annual income of a laboring man be estimated at an average of $400, the sum of $200,000,000 would provide this income for 500,000 men. Probably not less than this number of men were discharged in 1872-75 from employment in railroad

building, and in the building of new furnaces, mills, shops, etc., called into existence by the railroad excitement of 1870-71. The discharge of half a million men from ordinary labor is a more serious matter than the disbanding of an army of a million of men was in 1865, for the majority of that army when discharged had farms, houses and employment waiting for them—the farms, houses and employment they had left to go to the war. But the laborer discharged from railroad building has no farm to go to, even his home may have to be abandoned, and he may become a "tramp."

The estimates made have been based upon an actual cost of $30,000 per mile, but if we take the amount of money invested in railroad bonds and stocks the figures become much larger. Poor's Manual for 1884 shows the amount per mile, as based on bonds and stocks, to be nearer $70,000.

Mr. Kent chiefly objects to the folly of building railroads when material and labor are highest and decreasing the construction mileage when all other conditions are most favorable. Rise in prices seems to increase the building fever instead of checking it, as in Feb. 1880 when iron and steel had reached extravagant figures, yet the building did not reach a climax until 1882 with a score of 11,591 miles for that year.

The diagram shows an imaginary line indicating a safe regular increase in the annual work which would have amounted to the present mileage without causing the great fluctuations of the past, and the alternate "booms" and "panics" which have made so much mischief.

This line is made by plotting the figures in the last column of the table below:

	Miles of railroad built.	We should have built.	Miles.
1868	2,979	.....	2,979
1869	4,615	1,000 miles less, or	3,615
1870	6,070	2,000 " " "	4,070
1871	7,379	3,000 " " "	4,379
1872	5,878	1,500 " " "	4,378
1873	4,107	500 " more, "	4,607
1874	2,105	2,500 " " "	4,605
1875	1,713	3,000 " " "	4,713
1876	2,713	2,000 " " "	4,713
1877	2,281	3,000 " " "	5,281
1878	2,687	3,000 " " "	5,687
1879	4,721	1,000 " " "	5,721
1880	6,956	1,000 " less "	5,956
1881	9,789	4,000 " " "	5,789
1882	11,596	5,500 " " "	6,096
1883	6,755	500 " " "	6,255
1884, say	3,000	3,500 " more, "	6,500
Total	85,343	18,500 less and 18,500 more	85,343

Water-Supply for Fire Extinction in the Metropolis.*

In London the whole of the water-supply is pumped, and the average pressure is quite inadequate for fire extinction without the intervention of fire-engines. A large number of observations were made all over the Metropolitan area by the Board of Works in 1876, and it was found that the average pressure was only about 30 lbs. per square inch, when there was no extraordinary draught on the pipes, such as that required for fire extinction. And it is not surprising that this should be so. The pressure given by the water companies is that required by statute, or, otherwise, by the customers of the companies, and even if they desired to do so it might be doubted whether, in the words of the Select Committee of 1876-7, the companies would be "justified by their constitution in incurring expenditure for fire purposes," for which purposes alone would it be necessary for them to increase their pressure.

The quantity of water delivered for all purposes is sufficient to meet the demands for fire extinction. There are, according to Captain Shaw's reports, very few cases of short supply, and constant supply is being gradually extended voluntarily by the water companies. Hydrants have been put down by the Corporation throughout the city, and connected directly by branches with the constantly-charged mains of the New River Company, and they have on several occasions been found useful, though the pressure is not such as to admit of fire-engines being dispensed with in all cases. A few hydrants have also been recently introduced by the Metropolitan Board of Works in other parts of the metropolis. In the matter of pressure, however, the general metropolitan water-supply is undeniably deficient. There is a copious supply of water, in close proximity to the property to be protected, but it cannot be brought to bear upon a fire without the intervention of fire-engines.

The population of the metropolis in 1881 was 3,814,571, and the Metropolitan Board of Works area is about 121 square miles, including the city's one square mile. There are 55 land fire stations, 12 street, 127 fire-escape, and 4 floating stations; and the brigade consists of 588 officers and men. The annual average cost of the fire brigade for the three years 1880-2, was 99,880*l.*, or 26*l.* 4*s.* per 1,000 of the population. It is somewhat difficult to arrive at the value of the property destroyed by fire in the metropolis, but a calculation based upon the contributions of the insurance companies to the fire brigade, and upon evidence given by Captain Shaw and others before the Select Committee on the Fire Brigade, in 1877, would make it appear that in 1882 the value of insured and uninsured property destroyed by fire was probably considerably in excess of 2½ millions sterling, or about 588*l.* per 1,000 of the population. As compared with efficiently hydranted places, the cost of the fire-extinguishing service, and the fire losses, are very high in London.

It will be asked why the metropolis should have been allowed to remain year after year subject to the preventible drain of wealth indicated by these figures. The reply is that the past and existing state of things have not been submitted to in ignorance or willingly, but the difficulties surrounding the subject in the metropolis have been practically insurmountable.

More than twenty years ago the Select Committee on Fires in the Metropolis directed attention to the extraordinary facilities for extinguishing fires then existing in Liverpool, Manchester, and Glasgow, and to the efficiency and small cost of the fire services in those places; and more recently, in 1876-7, the Select Committee on the Metropolitan Fire Brigade, having heard evidence as to the advantages of the hydrant systems referred to, recommended that hydrants should be put down in the metropolis at once wherever a constant supply was given, and the water supply should be improved so as to give constant service everywhere, and increased pressure. But it was found that to comply with these recommendations a permament expenditure of 337,000*l.* per annum beyond the cost of the fire brigade would be involved. Of this annual sum about 150,000*l.* represented the increased cost of pumping alone; and since the quantity of water required for fire purposes is infinitesimal as compared with the quantity supplied for all other purposes, it is obvious that this expenditure of power if the whole had to be pumped to the requisite height, would be out of proportion to the result obtained. I have made a calculation, based upon the relative quantities, and upon the evidence given before the committee, from which it appears that for the purpose of discharging water through a hydrant upon a fire in this way, about 170 horse-power would be required for every gallon of water thrown. And there would be the attendant disadvantages that all the house fittings would have to be altered and strengthened, and the mains and pipes would have to be taken up, and relaid of greater size and strength, and at enormous inconvenience to the householders and the traffic in the streets; and the pressure would, in the greater part of the metropolitan area, be inconveniently great. This proposal also involved the great disadvantage that it could not be carried out until the water companies should have been ranged under one control.

As long ago as 1862, the late Mr. James Easton, who held the view that no satisfactory supply of water for fire extinction with constant high pressure could be secured in connection with the ordinary domestic supply, proposed to lay down a completely new set of mains to be used exclusively for fire purposes, but the cost would have been enormous. His estimate was 72,000*l.* per square mile, and his proposal only extended to 40 square miles of the metropolis. This area alone would have involved an annual cost for interest and working expenses of 150,000*l.* A somewhat similar proposal, but with the addition that the water was to be taken from the chalk formation at about 15 to 20 miles from the center of London, instead of from the water companies' mains, as was proposed by Mr. Easton, and that the supply was to be used for potable and culinary purposes after being pumped to the greatest attainable elevation in order that it might have sufficient pressure for fire extinction purposes, was put forward by the Metropolitan Board of Works, on the advice of Sir. J. Bazalgette, Sir. F. Bramwell, and Mr. Edward Easton, in 1877. It was estimated that the introduction of this system of hydrants would have resulted in an annual saving of 60,000*l.* in the existing expenses of the fire brigade. This scheme, involving a dual supply to every house, was taken to Parliament, but was withdrawn; and in their annual report of 1878, the Board said that they "came to the conclusion, in view of the disfavor with which the scheme appeared to be regarded by most of the local authorities of the metropolis and others, not to bring it before Parliament again in the following session." Looked at purely from a fire extinction point of view there is one great objection to all the proposals that have been hitherto made, viz., that owing to to the great variations of level in the metropolis, there would, in many localities, be insufficient pressure, while in others the pressure would be excessive.

In any water supply for fire purposes, it is certainly desirable that the pressure, in addition to being sufficient, should also be moderately uniform in the hose, whatever may be the elevation of the locality. This uniformity is practically obtained at present by the use of fire-engines, but with the great drawback that the power requisite for giving the pressure is not available on the instant that the occasion for its use is discovered. Since the year 1870, when Captain Shaw first began to publish the distances travelled by his engines, the distances run have increased from 11 miles to 34¼ miles (in 1882) per fire. The number of journeys made has increased from 8,000 to 29,000, and the total distances run from 22,000 miles to 66,000 miles in the year. According to the evidence given before Sir H. Selwyn Ibbetson's Committee in 1877, the fire-engines were then only used for pumping at about one-fifth of the fires. If that was still the case in 1882, then it follows that for each time the engines were used for pumping upon a fire they must have run on an average 172 miles.

When it is considered under what unfavorable conditions, and how uselessly the journeys are often made, some idea may be formed of the superiority of a system of hydrants where the power as well as the water is always on the spot ready for instant application. The growth of the cost of the fire brigade service, from the commencement of the old fire-engine establishment in 1883, has been and is very rapid as compared with the growth of the population. In the first year of the Metropolitan Board of Works' administration of it, the cost of the brigade was under 41,000*l.*; in 1882 it was 106,552*l.* or an increase in the period of sixteen years of 160 per cent., while the population increased only 28 per cent., and the number of fires 44 per cent. And in the year 1883, the cost had further increased to over 115,000*l.* It must not be supposed for a moment that this increase is to be regarded as unnecessary under existing conditions. The cost of the London Fire Brigade is, thanks to Captain Shaw's admirable organization, still small compared with some other unhydranted cities. In New York, as already stated, the cost is very much greater for less than a third of the population and area. There the average annual cost for the three years, 1880-3, was over 288,000*l.*, and it appears to be growing almost as rapidly as that of London, though on the other hand the population there is growing more rapidly. Paris, also another practically unhydranted city with half the population, spends proportionately more than London for fire extinction.

*From a paper by Mr. J. H. Greathead, read at a Conference at the Health Exhibition.

WATER.

THE new water-works at Independence, Iowa, have been completed, tested and found to work satisfactorily.

SAUK CENTER, Minnesota, will soon issue boads, bearing seven per cent. interest, to pay for a system of water-works.

THE Eddy Valve Co. of Waterford, N. Y. are making a fifty six inch (56") valve for wrought-iron Water pipe. Is not this the largest size made yet? The largest size on Croton Water pipe is 48".

DEAN BROS. Steam Pump Works of Indianapolis have just put in a large pump for the water supply of the Indiana State Insane Asylum. They have also furnished the Shelbyville (Ind.) Distillery, and the Empire Distillery at Chicago with pumps and vacuum apparatus for the new process of distilling.

Statistical Tables of American Water Works, Second Issue.

To Manufacturers of, and Dealers in, Water Works Machinery and Supplies; to Engineers and Contractors of Water Works Construction; and to the officers of Water Works Management.

In the history of class literature in this country, there is probably no case of such persistent effort to obtain exhaustive information on a special subject as has been exhibited by Mr. J. J. R. Croes, in collecting data for his projected "History and Statistics of American Water Works." Nearly four years ago preliminary work was commenced, and ever since there has been a steady stream of circular letters flowing from his office to the many sources of information on Water supply throughout the United States and Canada. The original intention was to have *some* account, as complete as possible, of *every* Water Works in these countries; we still expect to carry out that intention, although some companies, and even some municipalities, seem determined that we shall not. In collecting information thus far, after it has been fully established that the Water Works people would not give it, recourse was had to newspaper editors, city officials, local engineers and surveyors, contractors, and other parties, who in many cases assisted very materially. The collection of this material, condensing it, classifying and indexing for further use, and preparing it for partial previous publication in ENGINEERING NEWS has been a task that cannot be appreciated by parties unfamiliar with such labor. The collection of Water Works Statistics now in the possession of the indefatigable compiler, Mr. Croes, has no equal in this or any other country.

Preliminary to the "History and Statistics of American Water Works" the plan of publishing "Statistical Tables" was adopted. They give in condensed form a vast amount of invaluable information to parties interested: they record the list of existing works and the annual increase of construction; give an opportunity for eliminating errors; invite criticism, and so very greatly assist in clearing the way for the chief volume in preparation.

The Second Issue of "Statistical Tables" is now actually in the printer's hands, and will be pushed to publication as rapidly as possible. It will be identical in appearance, size of paper and type with the First Issue: it will contain returns to date of all the former Water Works, besides those of about 150 new ones constructed since the date of last edition; errors in the former edition have been corrected; more complete returns secured; all changes of officers recorded, and the Tables made as complete and valuable as painstaking and accurate labor can accomplish. Mr. Croes is one of the most conscientious of compilers and spares neither himself nor assistants in giving the very best that money and labor can procure.

The Tables will give the name of Town; State or Province; Population in 1880; Date of Construction of Works; Ownership; Source of Supply; Mode of Supply; Builders of Pumping Machinery; Cost of Works; Bonded Debt; Rate of Interest; Officers of Works; Expenses and Receipts; Daily Consumption; Miles of Pipe; No. of Taps and Daily Consumption per Tap; No. of Meters and Fire Hydrants and Annual Price per Hydrant by City; and Kind of Pipe both in Mains and Services, the whole containing in a very accessible shape the most important items of information regarding water supply.

The "First Issue" of the Tables was distributed gratuitously to every Water Works office of which the address could be obtained; to all advertisers; to engineers and contractors of water works; to every person by whom even the smallest item of Water Works news was sent to Mr. Croes, and beside all these to many city and town officials where works were contemplated, and to whomsoever it was deemed of service that a copy should be sent. In addition to this the U. S. Government has sent for copies preparatory to ordering copies sent to each military post where the subject of water supply is being considered.

The most diligent efforts have been used to place the edition in well selected offices, and in every way to reach the parties most interested in water-works matters.

The "Second Issue" will be disposed of in the same way. We *absolutely guarantee* its being placed in the office of *every water-works* in the United States and Canada: it will be sent to every advertiser—one to five copies as desired; it will be sent to all persons who have furnished any information about water-works, and to the other officials of any city or town contemplating water-works up to the date next of succeeding issue. *The intention is to place one or more copies in every office where the subject of water-works construction and maintenance is of interest.* The faithfulness with which ENGINEERING NEWS has always endeavored to fulfill its promises is a guarantee for the efficient manner in which the above agreement will be carried out.

The cost of publishing the book is very great. The expenses of compilation, the composition, paper, press work, binding and circulation, all together involve a large outlay. For all this, and for our own labor and risk we look for our return in the advertising patronage, which in our first issue was very liberal, and which we are assured by many new patrons will be considerably increased in this edition. The same rates as were charged before will be maintained now:

FORTY DOLLARS PER PAGE.
TWENTY-FIVE DOLLARS PER HALF PAGE.
FIFTEEN DOLLARS PER QUARTER PAGE.

Payable on delivery of a copy of the completed book. We have bought new type throughout for this special work, the typography will be first class, as also the press-work and paper. Special care will be taken with the advertisements. They will be set by a specialist in that line and proofs will be submitted to all advertisers for final approval. It is important that "copy" for advertisements be sent in as early as possible as we are crowding the text very fast and the advertisements are carried forward to press at once and independent of the other papers. They will be set and printed as fast as received.

We are very grateful for the generous patronage of the American Water-works Engineering, Contracting and Machinery and Supplies Manufacturing interests; we are doing our best to give value for that patronage, and with increasing facilities and revenues, we confidently promise that we will keep the lead in this important industry, which a decade of perseverance has fairly won for us. We now respectfully solicit your advertising patronage for this special enterprise, confident that it will recommend itself to your wise business judgment.

Address all communications to ENGINEERING NEWS Publishing Co., Tribune Building, New York City.

NEWS OF THE WEEK.

Railroads and Canals.

RIGHT of way has finally been granted by Salt Lake City to the Salt Lake and Fort Douglas Railroad,

THE advisability of an extension of the Memphis & Little Rock from the latter terminus to Hot Spring is under discussion.

THE Ortonville & Lake Superior Company has been incorporated to build a railway from Ortonville, Minn., via Benson and St. Cloud to Duluth.

THE Chicago, Milwaukee & St. Paul has completed its Cedar Rapids & Ottumwa branch, 90 miles long, by closing the gap of 43 miles between Amana, Iowa and Sigourney.

TRACK on the Chicago, Burlington & Kansas City, has reached Bogard, Carroll county, Mo., 21.1 miles southwest from Sumner, the terminus at the end of last year.

THE Asheville and Hendersonville Railroad is to be finished at once. There will be a road built to Knoxville by the Western North Carolina people as soon as the former is completed.

ON the Springfield and Northern branch of the St. Louis and San Francisco road, track is laid from Springfield, Mo., north 20 miles, to the Polk county line, and trains are running.

MR. NEWMAN ERB, receiver for the Memphis, Selma and Brunswick Railroad, says that the prospects are favorable for the completion of the section between Memphis, and Holly Springs, Miss., within the next ninety days.

MR. T. PARKER of Buchanan, Mich., has been awarded the contract to construct 40 miles of the St. Joseph Valley line, and sublet the grading, bridging and pile wood. He may be addressed as above.

The contract for furnishing four mail elevators for the post office and court house at New York has been awarded to N. B. Cushing at his bid of $6,200.

THE contract for iron beams, columns, etc., for the court house, etc., at Columbus, Ohio, has been awarded to L. M. Morris at his bid of $8,998.90.

THE Rome and Chattanooga Railroad will soon commence $50,000 worth of grading.

MAJOR GREENE has just finished a reconnoisance of the Gulf and Ship Island road southward, from Jackson, Miss., to the Gulf shore at a point between Biloxi and Mississippi City. This enterprise is heavily backed by the State of Mississippi.

THE contract for the masonry and carpenter work for the basement and superstructure of the court house, etc., at Jackson, Tenn., has been awarded to J. M. Marshall at his bid of $27,977.

TRACK on the Columbus & Cincinnati Midland has reached Sabina, O., 55 miles southwest from Columbus, O., of which 50 miles have been laid this year. Grading is completed to Clinton Valley, O., about 20 miles farther. This road is in the interest of the Baltimore & Ohio.

TRACK on the Marietta & North Georgia road has been extended from Marble Cliff, Ga., north 11 miles to Ellijay, reaching an extensive area of country that affords a large traffic. Grading is completed between Ellijay and Murphey, N. C., 30 miles.

THE Philadelphia *Record* says that at Easton, Pa., the construction of the Eastern & Bangor R. R., which was suspended about two years ago is about to be resumed. The company have put an engineering corps in the field under the charge of P. Brady, of Easton.

PRESIDENT MCINTYRE of the Springfield & Southern Company is reported as saying that $100,000 will be on deposit in London, Eng., on October 1st, for construction and the same amount each 30 days thereafter to the full sum needed. He also says that work will begin about October 1st.

GRADING is being done all along the route of the Minnesota and Northwestern to the Iowa State Line from St. Paul. About 2,500 men are at work, and they will be through, practically, by November 1st. It is not expected that track will be laid this year, but rails are now being delivered.

SUB-CONTRACTORS are opening up the work on the Sioux City and Pacific, continuously to the fiftieth mile west of Valentine, and about 400 teams are now at work. The grading of the entire 90 miles will probable be finished this fall, but bridging and tracklaying will be deferred till spring.

TRACK on the Baker City division of the Oregon Railway and Navigation Companies route at last accounts, was laid to a point 375 miles east of Portland, Ore., and 48 miles beyond the last mentioned terminus, leaving only about 29 miles to complete the line to Huntington, Ore., where it connects with the Oregon Short Line.

THE construction of a standard gauge railway to run from Colorado Springs to Aspen, Colo., is said to be among the possibilities. The projected route is through Ute Pass, across South Park near Alma, thence to Horseshoe, thence to Leadville, and from that point to Aspen via Hunter's Pass. It will be known as the Colorado Midland.

THE Ottumwa Cedar Falls & St. Paul R. R. (branch of the C. & N. W.) is now completed from Belle Plain to Muchachinock the present terminus—distance from Belle Plain 3.300 stations = 62.5 miles. The line is laid with 60lb. steel and is built first class in every particular; it is intended the road will do a heavy coal traffic. The S. C. & P. R. R. backed (by the C. & N. W.) have 90 miles under contract to build this winter.

A FINAL survey of the North Conway and Kearsarge Railway will be begun immediately, and it is expected that six miles of it will be constructed this season. Its charter empowers the construction of a narrow gauge line from North Conway to the summit of Mount Kearsarge, passing through Intervale, Lower Bartlett, Intervale Park, Kearsarge village and Chatham, N. H., and also through several towns in Western Maine. The line will be twenty-one miles long, consisting of three divisions.

IN the office of the Secretary of State, of Minnesota recently, there were filed articles of incorporation of the Moorhead and Southeastern railway. The road is to run from Moorhead in a southerly direction to some point on the south line of the State. The capital is to be $5,000,000, and the incorporators are Frank J. Burham, P. H. Zamb, F. E. Briggs, John Erickson, W. H. Davy, Andrew Hales, Thomas C. Kurtz, Erick Hanson, R. R. Briggs, and W. J. Bodkin, all of Moorhead.

THE Northern Pacific & Puget Sound Shore, and the Northern Pacific & Cascade are the names of two companies which have recently filed articles of incorporation in Washington territory. The roads are now in operation under the Northern Pacific management, and extend to Stuck Junction. The officers are: President, Robert Harris of New York; vice president, J. M. Buckley of Tacoma, W. T.; secretary and treasurer, Newman Kline of Tacoma; trustees, Robert Harris, J. M. Buckley, James McNaught, Newman Kline and Samuel Wilkeson, Jr.

THE survey of the Dunseith, Maine and Southeastern road, whose incorporation was noticed in ENGINEERING NEWS of August 2nd, has been completed throughout its entire length, a distance of 68¾ miles. The maximum grade will be only one foot to the 100. The cost of the grade will be about $1,350 per mile, or $98,812 for the entire grade. The road, completed and ready for operation, will cost 800,000, or $707,188 for the iron and ties, and the work of putting them down. This total amount has already been subscribed, and the grading is expected to begin in October. The road will be completed next season.

THE Minnesota Central has executed a mortgage on its property to the amount of $15,000 per mile on the roadbed, right of way, etc., and $5,000 per mile on the rolling stock and equipment. The road extends from Red Wing, via Cannon Falls and Faribault, to the junction with the Minneapolis & St. Louis road at Waterville, 66 miles. The money raised is to be applied to building an extension from Waterville to Gaylord on the Pacific division of the Minneapolis & St. Louis, and thence westerly into Dakota, and also to build bridges for an eastern extension, if needed, over the Mississippi at St. Paul or Minneapolis and at Red Wing, and over the St. Croix and Chippewa at points yet to be named.

THE Sioux Falls, Fairbank & Western Railroad Company has been incorporated in Dakota to build an extension of the Chicago, Iowa & Dakota. The charter provides for a road 600 miles long including branches, beginning at Sioux Falls, Dak., extending north and west to Deadwood, Dak., also a branch north toward Bismarck. The incorporators are: E. P. Caldwell, Huron; B. Tripp, Yankton; F. T. Evans, Pierre; and E. P. Clark, Oswego, N. Y.

HARRISBURG, PA., Sept. 22.—A charter was granted to-day to the Stewarttown Railroad Company, of York County. The road will run from Stewarttown to a po nt on the Northern Central Road between Shrewsbury and New Freedom Stations, a distance of seven miles. The capital is $100,000, and the president is James Fuller, of Stewarttown.

Miscellaneous.

PROPOSALS are advertised for the privilege of furnishing pipes and pumping machinery for the Marine Hospital at New Orleans, La. All bids must be in by Oct. 15th.

THE city government of Chicago and several railroad companies interested in the matter are discussing plans for a bridge and viaduct at Adams St. to cost about $100,000.

OF the three branches of engineering, mechanical to-day pays the best. The average civil engineer makes $2,000 per annum, the mining $2,200 and the mechanical $2,800. This includes bridge and locomotive construction.—*Exchange.*

THE mean rate of descent of the Mississippi at low water varies from 0.005 of a foot per mile at the head of the passes to 0.578 of a foot per mile at Cairo. During high water the rate of descent is higher at the passes, amounting to 0.115 of a foot per mile, while at Cairo it is only 0.497 of a foot per mile. From the head of navigation below the falls of St. Anthony to Cairo the rate is somewhat greater than at Cairo under the same conditions. At Rock Island the rapids add 24 feet to the whole amount. Distances by river: New Orleans to Port Hudson, 150 miles; New Orleans to Vicksburg, 400 miles; New Orleans to Cairo, 1,040 miles; New Orleans to St. Louis, 1,220 miles.

THE contract for building a railroad bridge across St. Louis Bay between Duluth and Superior was let recently by Gen. Anderson, Chief Engineer of the Northern Pacific R.R. The bridge will be nearly one mile in length, divided into three sections, as follows: Draw bridge, 246 ft.; the fixed truss span, 160 ft. and the pile bridging, 4,200 ft. The contract for building the truss was let to Salspaugh & Co. of Minneapolis; the pile bridging to the Detroit Iron Bridge Building Company, and the timber bridging to Winston Bros, of Minneapolis. By the terms of the contracts the entire structure is to be completed by the last day of January, 1885, and work will be commenced as soon as a few details are arranged.

PLANS have been prepared for a new county building at Accomac Court House, Va., to cost $25,000.

THE following is the only bid received for furnishing 28,000 tons of rip rap granite for the extension of the New Haven Breakwater:

John Beattie, Leetes Island, New Haven County, Conn., aggregate $32,760. He was awarded the contract.

THE following is an abstract of the bids for improving harbor at Brunswick, Ga.:

John S. Howell, mattress, 73¼ square yards; stone, $3.09 cubic yard; aggregate, $6,981.

Atkins & Hoffman. mattress, 65c.; stone, $3.48; aggregate, $7,631.

Contract awarded to John S. Howell.

THE following are the bids received for stone and brick work at Dallas, Tex., and which were opened in the Supervising Architect's Office, September, 12:

A Brownlee stone, $27,077; brick, $15,390.

Morgan & Morris, stone, $38,000; brick, $27,000.

Figh & Sanderson, brick, $17,900.

M. A. McGowan, stone, $37,500; brick, $14,990.

THE largest dredging machine in the world has been finished and will be used on the Sacramento and San Joaquin swamp lands in California. She has been named Thor, and modeled after the best dredges now in use on the Isthmus Canal, cutting out a channel and building a levee at the same time. The Thor is 101 ft. long and 61 ft. wide, and has thirty-four iron buckets with a capacity of one and a half cubic yards each, which can be filled and emptied fourteen times per minute.

ONLY one bid was received by General Meigs in response to his advertisement for cast and wrought iron pipe fittings. The bidder was A. W. Allen, of Philadelphia, Pa., who agreed to furnish the following for $2.35, which includes cast iron pressure fittings at .03½ per lb.:

16 wrought iron tees, 4x2½; 3 4-inch plugs; 16 2½-inch brass Chapman Valves; 1¼-inch brass Chapman Valves; 16 2½ close nipples; 24 wrought 4-inch iron hooks.

The following material was bought of J. L. Mott iron works of New York for $4,275:

14 5-inch ⅛ bends; 4 5-inch ¼ bends; 6 L 5-inch D. H. pipe; 20 fr. 5 inch; 6 brass ferrule and screws.

NEW-HAVEN, Conn., Sept., 22.—Proposals for five jobs of Government river and harbor work were opened in United States Engineer McFarland's office to-day, and awarded as follows: Dredging the mouth of the Connecticut River, 40,000 cubic yards, A. J. Beardsley, Bridgeport, 15 cents per yard. Pile dike extension, 400 feet, New-Haven Harbor, James Dubois, New York, $21.50 per foot. Ten thousand tons stone, west jetty at Saybrook, John Beattie, Leetes Island, $1.24 per ton. Extension breakwater at Greenpoint, Long Island, 7000 tons stone, Charles H. Edwards, Boston, $1.38 per ton. Dike in Thames River, 20,000 tons stone, Charles Edwards, Boston, $1.07 per ton. There was a remarkably large number of bidders.

THE following bids were opened at the office of Colonel Hains for dredging about a million yards of material from the Virginia channel, Potomac River.

Benson & McNee, San Francisco, 13.45c. per cubic yard; measured in place.

National Dredging Company, Wilmington, Del., 21c. measured in scow.

Moore & Wright, Portland, Me., 24c., measured in scow.

Morris & Cummings Dredging Co., New York, 25c., measured in scow.

Ross & Sanford, Jersey City, 16.3c., half scow measurement, half in place.

American Dredging Company, Philadelphia, 21c.

AT present 250 barrows are engaged upon the work of closing Davis Crevasse, La., and a train of cars are dumping dirt into the pits dug out by the crevasse. The levee is being built between the Texas Pacific track and the river, the curtain running very near the former, rendering the operation of dumping from the cars an easy one. About 300 men altogether are employed about the camp and on the levee. Work was begun on Friday, Sept. 5, and already 300 feet of the levee has been completed at the lower end.

The dimensions of the levee are as follows: Upper wing, 1141 feet long; curtain, 1684 feet; lower wing, 976 feet—total length of levee, 3801 feet. Of this 1008 feet of the curtain is across the gulch of the crevasse, The height of the levee is from 9.4 feet at the upper wing near the old levee to 13.8 feet where the levee approaches the railroad. From this point across the gulch the height varies, it being 31.5 feet at the point of deepest water.

THE following is a synopsis of the bids for delivering 50,000 cubic yards of rip-rap on board the Government barges in the Mississippi River 100 miles from St. Louis, Mo.:

Glenwood Lime and Quarry Association, St. Louis, $23,686.67.

Grafton Quarry Company, $22,500.

Martin Lorenz, St. Louis, $29,250.

Contract awarded to Glenwood Lime and Quarry Association.

THE following is an abstract for furnishing piles at the Government works in the Mississippi River between St. Louis, Me., and Harrisonville. Ills.:

Quantities.

7,000 piles, 30′ to 35′.
10,000 piles, 35′ to 45′.
3,000 piles, 45′ to 60′.

Aggregate Bids.

John Cleary, Chester, Ill., $54,175.
David Daniels, St. Louis, $100,375.
Contract awarded to John Cleary.

THE following is an abstract of the bids for furnishing material and labor for improving Calumet Harbor, Ill.:

1. Hemlock timber, 87,337 ft. b. m.
2. Pine timber and plank, 27,000 ft. b. m.
3. Pine piles. 40.
4. Wrought-iron drift bolts, 11,351,85 lbs.
5. Wrought-iron screws, bolts, nuts and washers, 640 lbs.
6. Wrought-iron spikes, 150 lbs.
7. Stone 246,804—1,000 cords.
8. Cost for 100 linear feet.
9. Cost for 200 linear feet.

Calumet and Chicago Canal and Dock Co.—1, $23; 2, $25; 3, $10.50; 4, 3½ c.; 5, 3½c.; 6, 3½c.; 7, $8.25; 8, $5,536.47; 9, $11,072,94.

Contract awarded to the Calumet and Chicago Dock and Canal Co.

THE following is a synopsis of the bids for improving the harbor of Cumberland Sound, Georgia and Florida:

Atkins & Hoffman, mattress, 67c. square yard; stone, $3.48 cubic yard; $857,710.

Levi S, Burrows, mattress, 74c.; stone. $3.49; aggregate, $59.850

J. H. Staats, mattress, 69c.; stone, $3.35; aggregate, $57,860.

Lara & Ross, mattress, 59c.; stone, $3.09; aggregate, $51,000.

Lara & Ross awarded contract.

THE following is an abstract of the proposals for improvement of the Charleston Harbor, N. C.

P. S. Sanford Ross, $232.950
Rittenhouse Moore, $308,250.
John F. Gaynor, $239,900.
Wm. H. Browne, $286,608.
A. A. Howlett, $230,500.
Contract awarded to A. A. Howlett.

THE following is an abstract of the bids for furnishing stone and mattresses for improving the harbor of Savannah, Ga.

Rittenhouse Moore—Mattress, $1.35 per square yard; stone, $3.40 per cubic yard; aggregate, $129,350.

P. Sanford Ross—Mattress, 57c. per square yard; stone, $3.30 per cubic yard; aggregate, $119,250.

John F. Gaynor—Mattress, 47c. per square yard; stone, $3.05 per cubic yard; aggregate, $119,250.

Contract awarded to John F. Gaynor.

BIDS for the construction of the annex to the Soldiers' Home, Washington, D. C.

Langley & Gettinger, $73,000.
C. Thomas, $66,500.
John H. Howlett, $72,300.
M. M. Magruder, $73,440.
Wright & McDermot, $65,795.
Joseph Driscoll, $68,565.
Wm. Henderson, $7,2450.
Bright & Humphrey, $72,870.
Walsh & Co., $67,997.
John H. Edelin, $72,875.
S. D. Phillips, $72,500.

The award will not be made until the board of commissioners of the home return to the city.

THE following is a synopsis of the bids for improving the channels over the bar at the mouth of St. Johns River, Fla:

John F. Gaynor, mattress, 69 cents square yard; stone, $3.59 cubic yard; aggregate, $138.050.

A. A. Howlett, mattress, 75 cents; stone, $3.10; apgregate, $130,000.

Henry S. Ely, mattress, 65 cents; stone, $4; aggregate, $145,500.

William H. Browne, mattress, 77 cents; stone, $4.48; aggregate, $165,900.

Contract awarded to A. A. Howlett.